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SOLAR HEATING AND COOLING SYSTEM INSTALLED AT RKL CONTROLS COMPANY, LUMBERTON, NEW JERSEY -- FINAL REPORT

Prepared by

RKL Controls Company
P. O. Box 276
Lumberton, NJ 08048

Under Contract EX-76-C-01-2397

Monitored by

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

U.S. Department of Energy

Solar Energy

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16. ABSTRACT

This document summarizes the final results of contract EX-76-C-01-2397, RKL Controls for solar heating and cooling of a 40,000 square foot manufacturing building, sales offices and the solar computer control center/display room. This report also provides information on system description, test data, major problems and resolutions, performance, operation and maintenance manual, manufacturer's literature and as-built drawings.

The RKL Controls solar system is composed of 6,000 square feet of Sunworks Double Glazed Flat Plate Collectors, External above ground storage subsystem, controls, ARKLA Absorption Chiller, Heat Recovery and a Cooling Tower.

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RKL CONTROLS

SOLAR SYSTEM

FINAL REPORT

INTRODUCTION:

The RKL solar project is located at the corner of Ark and Stacy-Haines Roads in Lumberton, New Jersey, at 39.8° latitude. It is approximately twenty miles due east of Philadelphia, Pennsylvania, centrally located in the highly industrialized corridor between Washington, D.C. and Boston, MA. At the time a cost-share contract was signed with ERDA, RKL Controls, Inc. was a privately held manufacturing corporation which owned land at the above mentioned site and had designed a building to be solar heated and solar air-conditioned for construction at this site. This building was to be designed specifically for solar heating and solar air-conditioning incorporating many novel design features. Before the system was completely finished, RKL Controls, Inc. was purchased by Robbins & Myers, Inc of Dayton, Ohio, with the transfer of ownership taking place in December of 1979. Final acceptance of the solar system occurred on November 1, 1980.

It should be noted that RKL Controls, Inc. were the designers, contractors, and owners of the facility.

The solar system became operational in October of 1979, on a manual, day-to-day basis for heating only.

During the summer of 1980, it became operational on a manual, day-to-day basis for air-conditioning only. Finally, in October, 1980 it became operational for heating and air-conditioning and was fully computer controlled.

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DESIGN PHILOSOPHY

It was the object, originally, to design an extremely energy sensitive building with a solar system incorporating the proven flat-plate collector to accomplish fifty percent (50%) of the heating load and forty percent (40%) of the air-conditioning load. It was also desired to design the unit with undersized collecting surfaces and oversized storage ability. It was also further desired to incorporate the latest technologies of micro-processors to completely control the system, collect data, analyze the data, and based on the analysis, pick the best modes of operation for a particular existing weather condition, all of this being done on a real time basis.

It was desired that the building and the solar collecting system be separate and that the collection system be located a ground level. It was to be as well protected as possible from the elements, be easily maintainable, with the possibility of vandalism kept as low as possible.

We also desired to make the solar system as flexible as possible with redundancy included in mechanical equipment wherever possible, thereby eliminating the possibility of shutting down the system due to a single equipment failure. The flexibility we were concerned with was in our piping and valving

so that switching could be made to multiple storage tanks either charging or discharging the tanks in parallel or in series.

It was further desired that the heat exchanger between the collecting loop and the storage and distribution loops be designed to operate at a minimum differential of two degrees Fahrenheit (2°F.) and that the air handling units within the plant also operate on a two degree Fahrenheit (2°F.) differential between plant air temperature and hydronic temperature.

In the design of this plant, which encompasses a typical machine shop, assembly, and test operation for the manufacture of control valves, we desired to include all types of energy saving devices and equipment. This ranged from high efficient electric motors to overhead barbershop type fans, and sodium vapor lighting throughout. As this was also one of the largest cost-sharing contracts under PON #1 and one of the few manufacturing facilities that was completely heated and cooled by solar, we set aside a section of the plant to become our computer and control center, designed in such a way that visitors could observe the operation of the solar system without interrupting normal manufacturing operations.

DESCRIPTION OF SOLAR ENERGY SYSTEM AND BUILDING

The building, housing our manufacturing, sales and solar computer control center/display room, consists of 40,000 square feet of floor space and is of the conventional steel post in wall construction with a flat roof having a pitch from West to East of one foot (1') per hundred feet.

The offices are located on the South wall of this building with the solar computer control center/ display room and the mechanical room in the Southeast corner.

The entrance to the offices of RKL Controls is nearest the parking lot and the West end of the South wall for convenience of employees, with a separate entrance into the display room at the East end of the South wall.

The only windows are on the South wall and consist of six foot (6') high, six inch (6") wide slit windows, double glazed for low energy loss, narrowness to prevent breaking and entering.

The walls between the offices and the manufacturing area are insulated both to prevent noise penetration and loss of energy, as the manufacturing area is generally kept cooler in the winter and warmer in the summer than the offices.

All entrances to the building, either man-doors or loading doors, were surrounded by air locks with double doors, including overhead doors.

The overhead doors were especially designed, fully internally foamed metal construction, one and a half inches (1½") thick with seals on all four edges and between panels. They are interlocked in such a way that no door from the outside can be opened at the same time as an inside door.

All man doors open outwardly with emergency panic bar control for easy exit from the building in case of emergency. Entrances from shipping and receiving are on the East wall of the building, as prevailing winds are from the Southwest, with large machinery loading and unloading doors on the West side, which are only opened occasionally. The North wall has no openings into the building.

The building itself is insulated on the outside with a two hundred and fifty pound (250 LB.) density sprayed urethane foam on the vertical walls (1-1½" thick) and a three hundred and fifty pound (350 LB.) sprayed urethane foam on the roof (2½-3" thick). RKL Controls Construction Division bought the equipment and sprayed the external surfaces so that there was a homogeneous insulated cover on the surface of the building. The urethane surface was spray painted with a special UV resistant, white acrylic paint, such coating being approximately 50 mils thick, consisting of two (2) coats on the vertical surfaces, each coat being sprayed in two directions, and one heavy coat on the horizontal surfaces, being sprayed in two directions.

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All fresh air vents, sky lights, and smoke vents were installed before the spraying operation so that no separate sealing would be necessary.

The foam was sprayed directly onto the cement block and directly onto the W-form steel roof deck so that extremely tight adhesion would occur.

This insulation has proved extremely satisfactory in making the building very air tight. Spraying the foam on the outside of the building eliminates any toxic gas effect within the building if there should be a fire, and allows the mass of the building to become a large heat sink thus increasing our storage capacity.

By spraying the foam in place onto the steel deck and cement block walls instead of a layup of urethane sheeting, we were able to eliminate all seaming seals on the surfaces. Spraying saved a tremendous amount of labor and consequently reduced the cost of insulation.

The sprayed urethane is pliable and expands and contracts with the building without cracking.

Within the building we located four large air handling units with extremely large built-in copper fin-tube heat exchanges. These air-handling units are located in the manufacturing area with dual speed fan motors and are so constructed that there are four sets of four coils in each air handling unit. This allows us to preheat with low quality solar heated water and do final heat with high quality solar or electrically heated hot water to gain the maximum use of the solar energy storage. Each air-handling unit has eight automatic valves, manufactured by RKL

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Controls, which allows any one of all four coils to be used in any combination of preheat and final heat. One of the large air handling units has a heat pipe system build into it that preheats fresh air brought into the building, from the outside, on a 24 hour basis. Pre-heating occurs by removing the heat from the exhaust air and transferring it to the incoming air, via a heat pipe system which is approximately sixty percent (60%) efficient. Also each one of these air-handling units has automatic louvers which allow us, during cool, dry nights in the summertime to bring in cool, dry air, thus reducing our air-conditioning requirements during our heaviest load periods. These fans are sized to completely change the air within the plant within ten minutes. All of the air passing through these air-handling units is filtered. The discharge is downwards throughout a 360° pattern. The air-handling units in conjunction with twelve (12) overhead, barbershop type fans located two (2) feet under the ceiling between bar joints, allows us to maintain a two degree Farenheit (2°F.) differential between the floor and the eighteen (18') to twenty (20') foot ceiling. Two smaller dual speed air handling units circulate filtered air from the plant through the offices and back out into the plant. All of the air-handling units are fully controlled by the computer and any one or all can be turned on at any given time, depending upon the conditions in the area that a particular air-handling unit services. All of the control between the computer and these air-handling units is accomplished

through optically isolated relays.

Room air temperature sensing occurs at one location and three different levels within the offices, ceiling, six feet above the floor, and three feet above the floor. Air temperature sensing occurs at three different levels and four different locations within the plant.

Relative humidity is sensed within the offices, within the plant, and outside the building, as is outside air temperature, wind direction, and wind speed.

Each of the shipping and receiving air locks as well as the mechanical room itself has vent fans blowing out of the building in the cooling season and into the manufacturing area during the heating season. The main shipping/receiving air lock has the air compressors located within it and these air compressors generate heat which is used to help heat the plant manufacturing area. The mechanical room also becomes quite warm during solar collection periods and this heat is circulated into the plant to help with our heating load. During the summer months the mechanical room becomes quite warm and fresh air is circulated throughout the room to the outside to help reduce the cooling load of the building. The same is true with the air in the air locks during summertime. Temperatures within these areas are sensed, and the computer makes the decision whether to circulate air from the various air locks and mechanical room into the plant or to the outside,

All partitions between the mechanical room and the manufacturing area are insulated with vermiculite inside of the cement block walls to prevent heat loss or gain into these areas.

Four sky-lights in the manufacturing area also serve as drop-in type smoke vents in case of fire. These sky-lights are double glazed plexiglass with a gold flash inside the outer plexiglass layer to reflect as much infared during daylight hours as is possible.

All internal and external man-doors into the air locks are one and half inches (1½") thick with fully urethaned foamed cores. Door lights are six inches wide by two feet high, double glazed.

The display room itself has a seventeen foot high ceiling with (3), four by six foot double glazed panels looking into the machanical room. This room contains our computers behind a partition with office area above and our L-shaped solar control console. There is space for approximately twenty people at one time to watch what is going on in the solar collecting area over closed circuit television, and observe what is going on in the mechanical room.

The mechanical room has all piping and control valves located eight feet above the floor or on the walls. All solar piping is made of glass reinforced high temperature modified epoxy and is used throughout the collection loop, the storage loops and the distribution loops.

The distribution loops to the air-handling units within the manufacturing area are of the fully balanced continuous return type. There are two parallel distribution loops, one for low quality energy from one source for pre-heating, and the other for high quality energy from another source which could either be storage or our auxillary hot water heater, for final heating purposes. The same is true for cooling purposes. In other words, low quality energy for pre-cooling and high quality energy for final cooling.

All valves within the system except handwheel operated isolation valves are pneumatically operated with all control solenoids located in one panel, optically isolated from the computer. Pneumatic relays on each control valve are operated by these solenoid valves. There are seventy-five (75) temperature sensors located in various sections of the piping system for use in computer analysis of the data collected. We chose to use thermisters in all cases for ease of multiplixing.

The advantages of the above mentioned high temperature plastic piping are quite obviously, the weight of the piping, the ease of the fabrication, as all fittings are epoxyed in place, and cost , which was a great deal lower than copper piping. This plastic piping has an operating temperature of 225°F. at 100 PSIG ,well above our maximum operating temperature of 210°F. and maximum working pressure of 50 PSIG.

All piping is connected to each piece of mechanical equipment with elastomeric expansion joints manufactured by RKL Controls. Expansion joints are also located in long runs of this pipe at specified intervals.

There are one hundred and eighty (180) control valves in the system, all of the RKL Controls' type SG, or SGE, which offer absolutely drop tight closure, corrosion resistance, and extremely low pressure drop. These valves are used, not only in the mechanical room,but throughout the distribution system and on the air-handling units.

The storage loop piping is so designed that we can either store in series or in parallel,to any one or all five storage tanks. At the same time we can remove from any or all tanks in series or in parallel depending upon conditions we want to achieve. This facility, as we mentioned before, was designed not only as a practical heating and cooling demonstration, but also as a research facility, thus the reason for our high degree of flexibility.

The auxiliary hot water heater is located in the mechanical room as are the two (2) twenty-five ton (25) ARKLA chillers and the eight (8) Ingersoll-Rand outboard bearing pumps.

Also located in the mechanical room are the water treatment systems for our potable water and our cooling tower water. The latter is used only during the air-conditioning season.

The solar storage system consists of six (6) tanks, four (4) of which are ten thousand (10,000) gallons, and two (2) of which are five thousand (5,000) gallons. These tanks are located just outside the East wall of the mechanical room, above ground.

They are of stainless steel construction, 20' tall, standing vertically, and are insulated with 6" of sprayed urethane insulation, painted white. There are four (4) six inch (6")diameter pipes connected to the storage loop inside of the mechanical room, two at the bottom and two at the top with internal vortex eliminators. Each tank has a stainless steel hinged man-sized inspection port at the top,and are vented to atmosphere. Also each tank has a temperature probe located at the bottom, the middle, and the top with an extension pipe that goes to the center of the tank. All tanks are connected to the plastic piping entering the building with elastomeric flexible connectors manufactured by RKL Controls and each pipe is insulated with two inches (2") of cast urethane foam, covered with an ultra-violet resistant polyvinylchloride white, glued in place plastic sheeting, as is all of the piping external to the building.

The solar collection loop leaves the Southeast corner of the building, crosses a bridge to a bermed area, down inside the berm, forming a fully balanced loop within the berm, where the solar collectors are located. The bridge is of the single suspension type,

suspended from the building with stainless steel wires and is constructed of standard beam forms of pultrusion type epoxy plastic reinforced with glass,as are all pipe supporting bridges in the berm area. These bridges require no maintenance,such as painting.

The berm itself is constructed of earth from the site and is so designed that when the arrays are horizontal they are below the edge of the berm and out of sight. The berm acts as a wind shield preventing damage to the arrays during high wind conditions,such as the occasional hurricane force winds that come across Southern New Jersey every two or three years.

The solar collecting arrays consist of twelve sub-arrays located in two rows of six each. Each sub-array is individually controlled so that it can be tilted on an East-West axis from an upside down condition to the correct angle for optimum collection on a given day or given hour of that day. Each sub-array consists of twenty-seven Sunworks flat-plate collectors, double-glazed with selective surface copper sheet and tube.

There are three rows of nine solar collectors on each sub-array and each row is connected to the one above so that there is a cascading effect for high quality energy collecting. There is a centrally located starter relay control panel in the berm, with manual override for each sub-array which is driven at one RPM by a one horse power double reduction gear motor through a heavy link chain drive.

There are two headers, one at the inlet and one at the outlet, bottom and top respectively, which run to either side of the sub-array. These inlet and outlet headers are connected to a 2" ID looped wire-reinforced high temperature hose which is in turn connected to its respective inlet or outlet loop at the base of the arrays.

Each sub-array is isolatable with RKL pinch type handwheel operated shut-off valves and each sub-array has a relief valve located at the highest point. The individual collectors are connected to each other and the headers with high temperature EPDM flexible hose to take up for expansion and contraction.

Sub-array structures are constructed of structural steel members and a tubular steel shaft with self aligning bearings at either end. There is a common A-frame support between each sub-array and an individual A-frame support at either end anchored to large 12" thick concrete pads at each leg. Each leg is held to the pad by three (3) adjustable clamps with bolts buried in the pad for easy alignment or re-alignment if any pad should shift.

There is an Eppley Photometer located on its own collapsible support between the south row of six sub-arrays, exactly in the center of the line of six sub-arrays. It is easily lowered for inspection and cleaning.

Each sub-array has its own inclinometer which feeds back to the computer for exact positioning. There is also a high temperature probe on each sub-array, placed

against the collector absorption surface of the top central collector for monitoring temperatures and indicating any stagnation conditions.

At the end of the return collection loop within the berm, there is a three inch (3") relief valve which discharges into a holding tank so that any overpressuring due to stagnation or other reason will discharge the propolene glycol, used during the winter months, into the holding tanks, thus preventing a spill. The flat surface inside the berm under the array area is covered with a light road-bearing bituminous concrete, black in color, for easy access to each sub-array for repair and maintenance and to absorb heat during the summer months,which radiates up towards the upside down collectors after darkness so that residual heat decay will be reduced during our heavy load cooling season.

The entrance to the berm is located on the East side away from the direction of prevailing winds. The berm also serves to reduce edge losses during the winter season when winds average five to ten(5 to 10) miles per hour.

Each sub-array is spray foamed with urethane on the back side so that moisture and ice will not collect on the backside of the arrays between its structural beams, when they are upside down during dark conditions or stormy weather. This also reduces back side heat loss, of individual collectors, to practically zero (0).

The complete solar loop holds approximately two thousand gallons (2,000) of a fifty percent (50%) solution of propolene glycol and water during the winter months.

This propolene glycol and water is drained into the two thousand (2,000) gallon holding tank, located in the berm, from the solar collection loop during the summer months and replaced with water. This prolongs the life of the propolene glycol. We also gain the advantage of using water, during our highest load cooling season, which has a better specific heat than the propolene glycol/water mixture.

Because the arrays are rotatable to an upside down position during windy or bad weather conditions and at night, the maintenance involved in keeping the double-glazed surface clean is reduced drastically. Also we do not have to wait for any snow or ice to melt from the collecting surface of the flat-plate collectors during winter weather as no ice or snow collects on the double-glazed glass surface.

Each row of six (6) sub-arrays are spaced in the berm area so that mirrors can be added, if desirable, at a later date without being shaded by the berm or the Southern row of sub-arrays. The complete area is fenced with a ten foot high (10') chain-link fence to prevent vandalism or damage to the area by inquisitive people.

Just East of the storage tanks, on a separate pad is located the cooling tower which is only used during the cooling season. It is a conventional open cooling tower circulating air through it from West to East, which is the prevailing wind direction.

The berm, 40,000 square foot manufacturing facility, and parking lot occupy approximately five (5) acres in the Southwest corner of a presently-owned thirty acre piece of land with its own fire protection pond, at the corner of Ark Road on the West and Stacy-Haines Road on the South, in the town of Lumberton, New Jersey. All drainage from the property and from the berm area enters the holding/fire-protection pond.

Television surveillance cameras are mounted in the parking area and on the top of the berm at the Southeast corner to give us surveillance of the solar array area from the computer room. We also record from these cameras, by stop motion recorder, for a period of three days (3) before the tape is erased and re-recorded.

The parking lot is lighted by high-pressure sodium vapor street lights for low energy usage, as are all external lights in the berm area and on the building itself.

ACCEPTANCE TEST

As the system became operational beginning in the Fall of 1979, using only manual operation, it was decided to put off the formal test plan until the computer programs were finished and de-bugged to the point where they could completely operate the system in both the heating and air-conditioning modes without manual assistance. The cooling mode programs were completed in the Summer of 1980,and were run for quite some time before the heating season occurred. In early October of 1980, the heating programs were run and de-bugged. Finally, on October 29, 1980, Mr. Jim Hankins of NASA arrived to observe both programs running and to check on the efficiency of the solar collecting loop. Both the heating and the cooling programs ran satisfactorily and it was determined by Mr. Hankins that the solar collecting loop had run at about thirty-five percent (35%) efficiency, which was in the area that we expected.

It now remains for us to collect data over an extended length of time, analyze the data, determine whether any changes to the computer programs would be advantageous,and if so,make these changes. However as the system now stands RKL Controls has accepted the design, the construction, and the operation of the system.

As we do have the capability of chosing from some sixty-four (64) possible modes or combination of modes, we plan to experiment with the system over the next few years to see if we can increase the efficiency to a level where we can completely separate ourself from any auxiliary source of heating and cooling.

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PREDICTED SYSTEM PERFORMANCE

It is our firm belief that this system at RKL Controls can accomplish 100% heating and cooling in a hands-off operation with relatively low maintenance.

This can, however, only be accomplished if the necessary effort is expended.

First, it is required that the computer be reprogrammed to increase efficiency.

Second, it is absolutely essential that management and employees be educated towards developing attitudes which would lead to the understanding of the necessity for further research on this project. Energy conservation is one of the most important issues facing this nation, not so much for this moment, but for the future. The vision to see that point is of utmost importance.

MAJOR PROBLEMS AND THEIR RESOLUTIONS

As this system has been operational in various modes manually for the past year and a half, we have discovered most of the major problems. Corrective action was taken at the time the problems arose. At the time of official acceptance most of these problems had been eliminated. Some of these problems are listed below:

Leakage of hose connection between the flat-plate collectors due to faulty installation of the hose connectors. As leaks have occurred the short length of hose between the connectors has been lengthened and more care has been taken in applying the hose clamps.

Leakage of the hose loops between the solar collector loop and each individual sub-array. The original hose specified was of too light-weight construction and many pin holes were found in this wire-reinforced radiator type hose. We eliminated the problem by going to a heavier EPDM steam type wire-reinforced hose with swaged screw connections at both ends.

We have had some problems with limit switches on the sub-arrays which were primary for safety shut-off to prevent overtravel. These switches are being replaced with a better grade switch and being relocated to prevent this problem from occurring in the future. Also these limit switches will have a back-up limit switch for redundancy purposes.

The other major problem area has been with our microprocessors in the control room. They have failed due to electrical outages. We have now attached the microprocessors to the UPS's so that we can go through an orderly shut down of the microprocessors without creating problems when the main power into the building comes back on.

The rest of the problems are relatively minor; the failure of a solenoid operated control valve, dirty air, moisture in the air, and so forth.

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LESSONS LEARNED AND RECOMMENDATIONS

The major lesson learned is that this project probably should have been limited to a bare bones heating and cooling facility, not as a research and development as well as an operational heating and cooling facility. If this had been done, a great deal of the instrumentation, the number of operating modes and so forth could hvae been eliminated, as well as a number of control valves and a large part of our piping. This would make the system much more cost effective.

We have also learned that the programming should have been done from the beginning by an outside consulting firm, as there would be much more depth in programmers to take care of any loss in programming personnel during the development stage of the project. This would have been less costly in the long run, both in time and money.

Some of the lessons learned that are on the positive side are that the urethane foam on the outside of the building gives a much tighter and consequently a much more energy efficient building than other types of construction. It is extemely satisfactory.

We have also learned that having the oversized storage, which is less expensive than collector arrays, has contributed greatly to the success of this project, as we are able to operate our heat distribution system from storage for periods of up to five (5) days when we can not collect solar energy. We have also learned that having multiple tank storage makes it easier for us to obtain high quality energy faster during short periods of high intensity sunlight.

The fact that we can rotate our collectors, turning them upside-down during bad weather,makes them more efficient in the winter time when snow and ice conditions are prevelent,as well as allowing us to increase efficiency during clear weather by tracking in a North South plain on an hourly basis.

We have further learned that the double glazing and cascading has allowed us to reach a higher quality level of energy, and that flat plate type collectors can be used to operate absorbtion type chillers without the necessity of going to a very expensive concentrating collectors.

Another plus has been the berm surrounding the solar collecting area. Comments have been very good from neighbors as to the aesthetic value of the berm and we do gain quite a bit by the reduction of edge losses of our collector surfaces as well as protection from hurricane force winds, which we have experienced twice in the last two years.

We have also learned that the overhead barber shop type fans have been very successful in distributing our heat from floor to ceiling level in a much more uniform way and that the sodium vapor lighting has decreased our electrical energy cost.

The air locks between all of the outside entrances and plant entrances are also valuable in keeping down energy losses from the building.

The location of the solar storage tanks above ground need not detract from the beauty of a site if properly located. They are much easier to maintain and there is less energy loss from our storage system during our heavy load cooling season when

we are able to store high temperature water for operation of the chillers at night time. There would be a much higher loss if these tanks were located underground

Of course the advantage of having the solar collectors at ground level is obvious. Maintenance problems are reduced drastically. There is also the cost consideration of mounting collectors on the roof of a building due to additional support members for the roof and the fact that an exposed array system on the roof of a building is subject to wind damage, and people walking below could be hurt by falling glass or debris. All of these problems have been eliminated by having the array system at ground level.

STATEMENTS VERIFYING THE SOLAR SYSTEM

The solar system was built as per design drawings which were changed during the course of the building operation. However, it must be kept in mind that RKL Controls was the designer, the contractor,and the owner of this building, so decisions to change these designs were relatively easy to make during the building and construction phase of the project. RKL Controls accepts its own designs and construction without hesitation and feels that the acceptance tests were more than satisfactory.

RKL Controls also feels that all the interim performance criteria requirements were met.

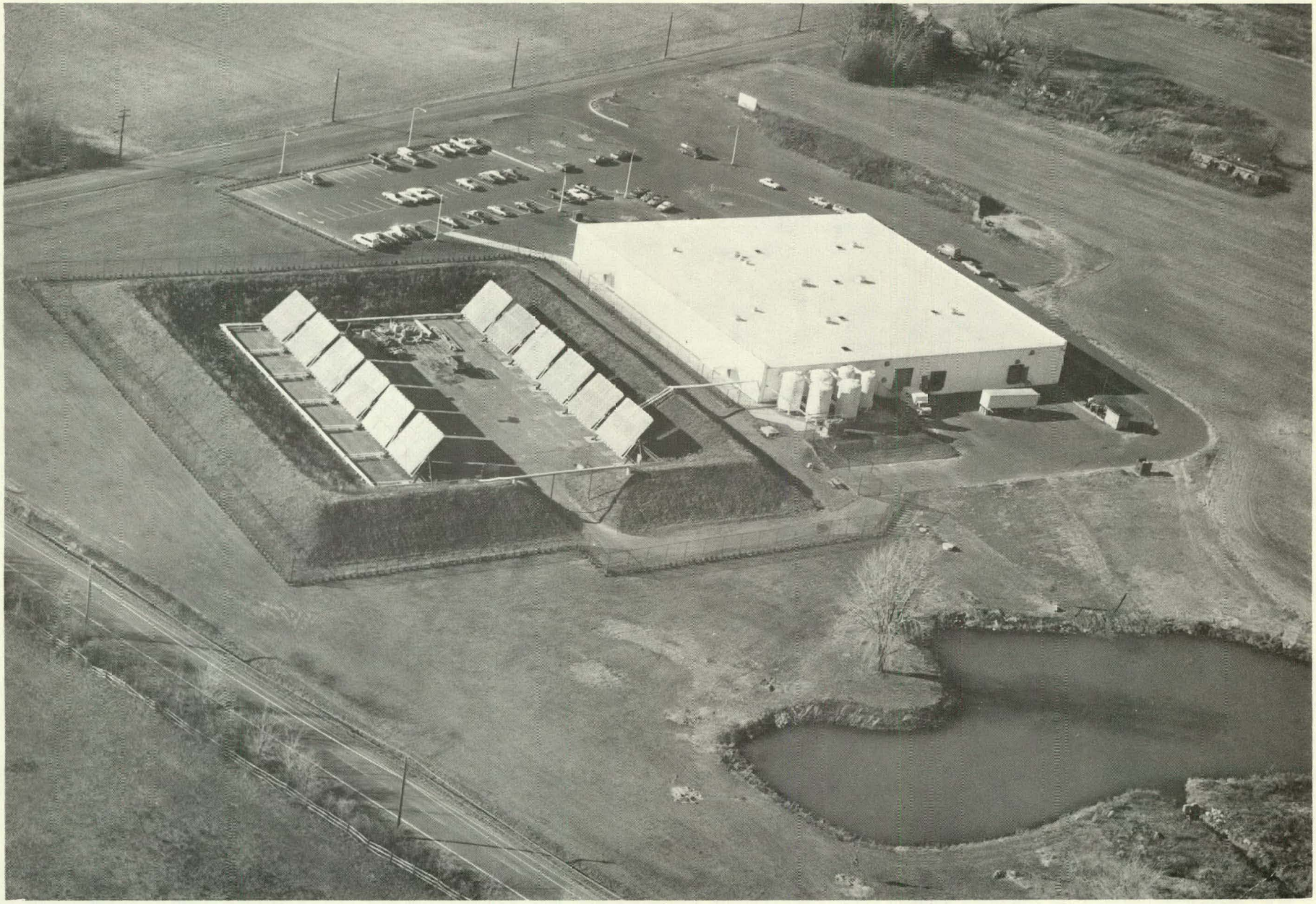
Respectively submitted,

Robert K. Little
Solar Manager
RKL Controls

RKL/kll

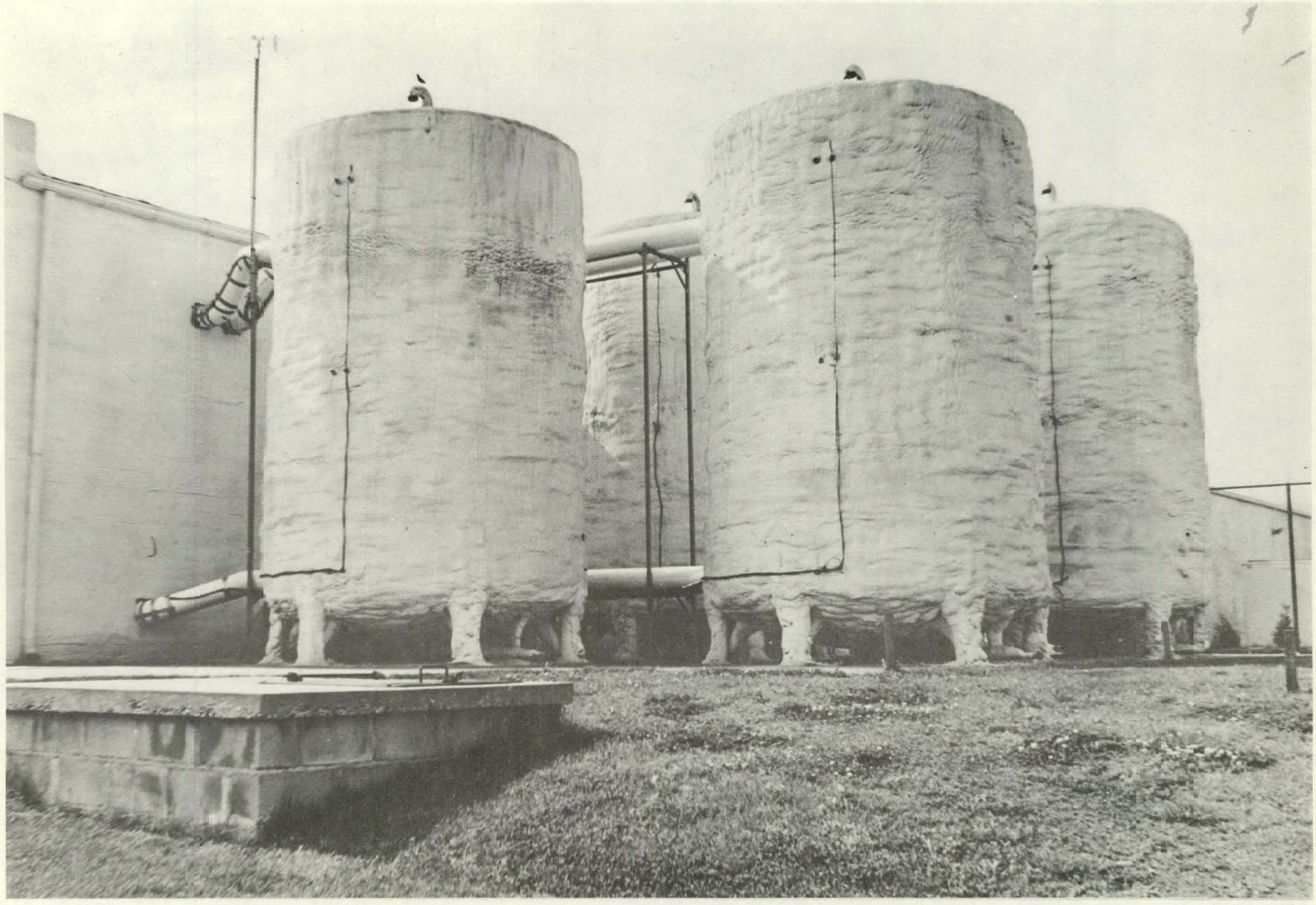
PICTURE INDEX

DESCRIPTION	PICTURE PLATE NUMBER
Aerial View of RKL Controls	1
Storage Tanks	2
Solar Arrays	3
Computer Control Consol	4
Plant Air Handling Unit	5
Mechanical Room - Pump Alley	6
Mechanical Room - Aux. Heater	7
Mechanical Room - Control Valves	8



PICTURE PLATE #1

RKL Controls Solar Heated/A.C. Mfg. Plant
Looking N.W. Dec. 1980



PICTURE PLATE #2

RKL Controls

Four of Six Storage Tanks covered with 6" of foamed Urethare Insulation.



PICTURE PLATE #3

RKL Controls

One of two Solar Arrays each consisting of six Sub Arrays



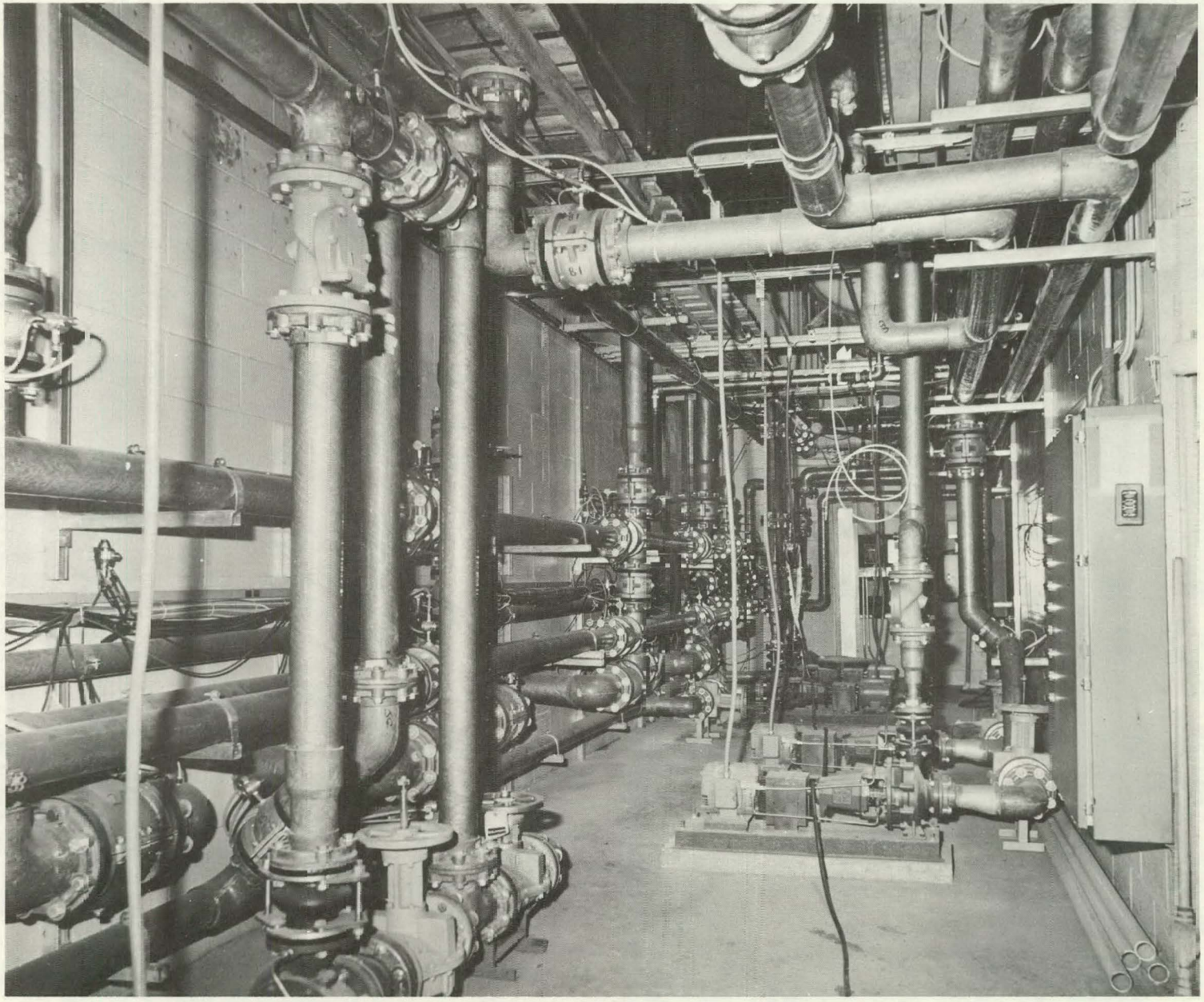
PICTURE PLATE #4

RKL Controls Solar Computer Consol in Display Room



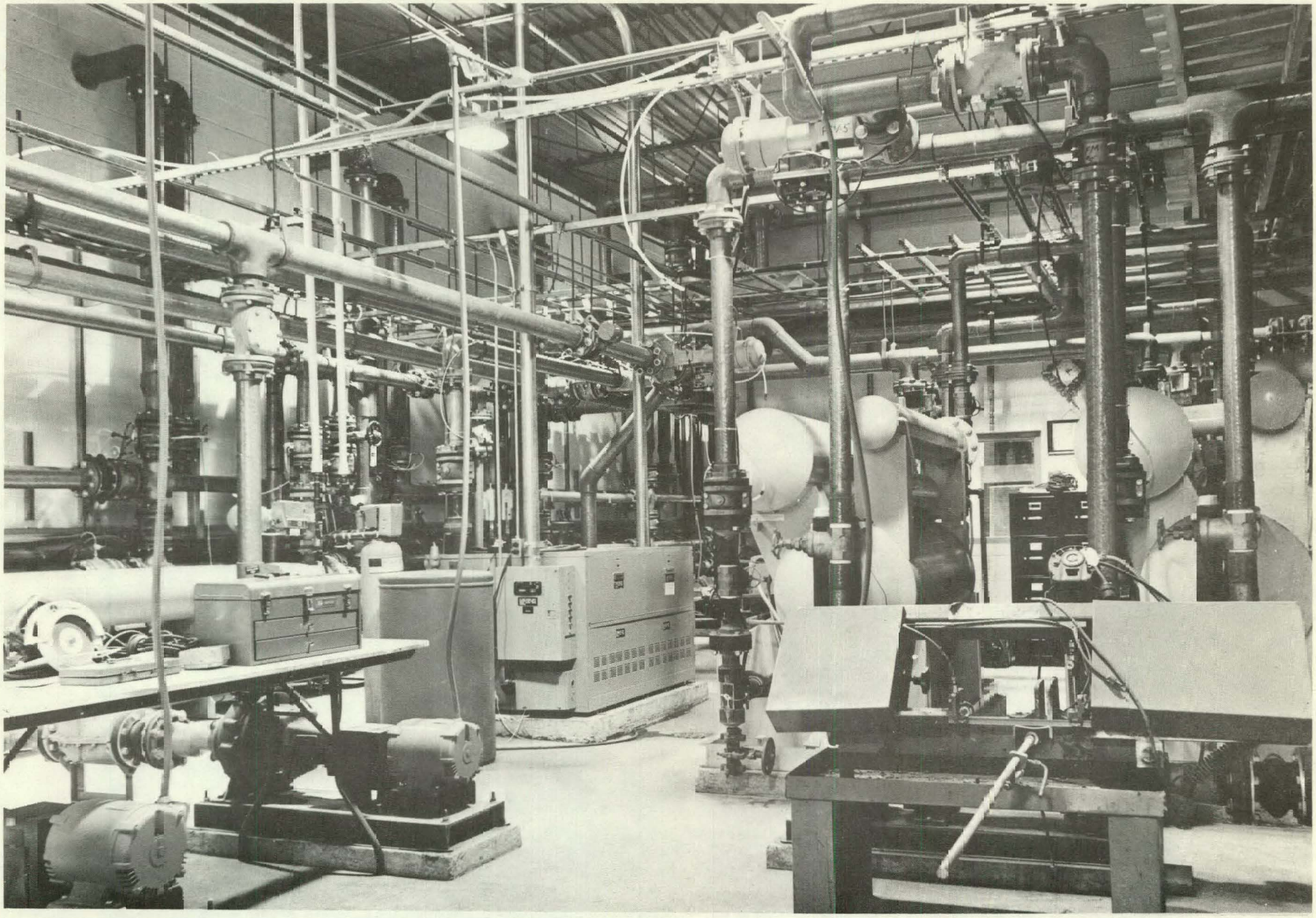
PICTURE PLATE #5

RKL Controls Solar hot/cool water heat exchanger Air handling unit with automatic Control Valves



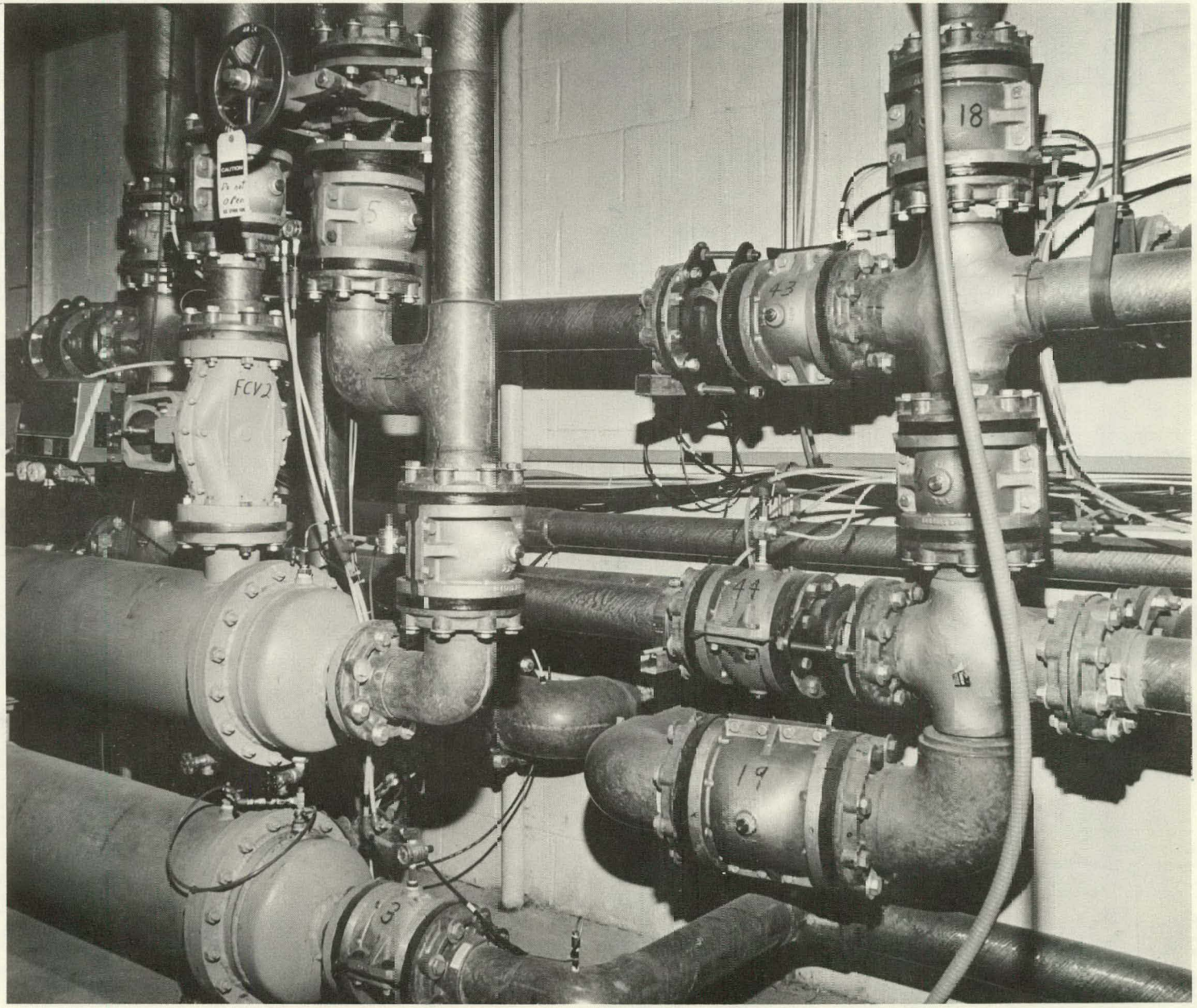
PICTURE PLATE #6

RKL Controls Solar Mechanical Room
Pump Alley look-ng South



PICTURE PLATE #7

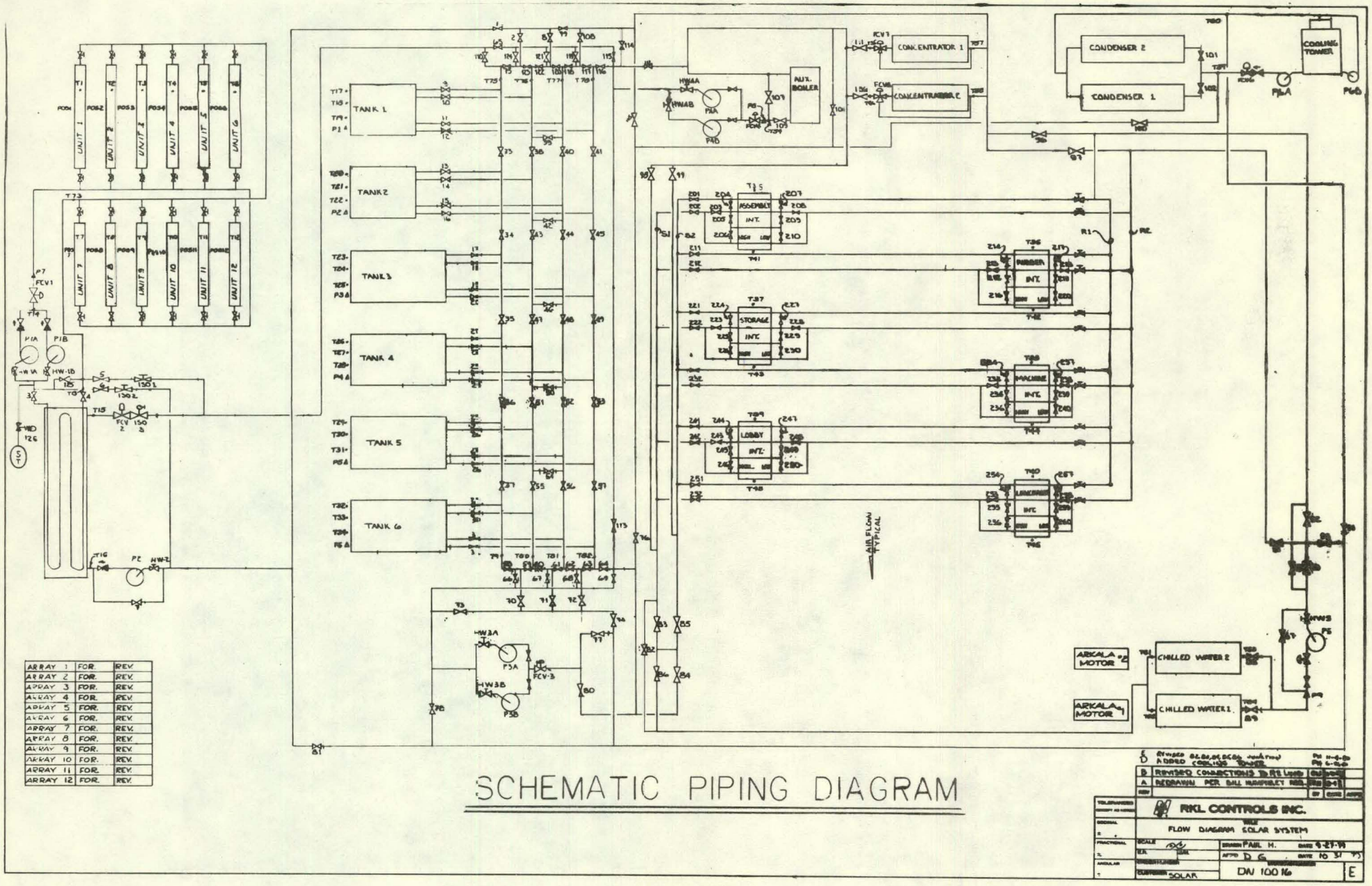
RKL Controls Solar Mechanical Room showing Valving, Piping, Chillers and Auxiliary Boiler



PICTURE PLATE #8

RKL Controls

Solar Mechanical Room - Section of East wall showing Piping, Control Valves, and enc of Solar Loop Heat Exchanger.



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

SCHEMATIC PIPING DIAGRAM

D	REVISED CONNECTIONS TO P3 LOOP	
A	REDRAWN PER BILL HUMPHREY REQ.	

RKL CONTROLS INC.

FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. 9-27-79

APPD D.G. 10-31-79

SCALE NONE

SOLAR

DW 10016

E

Typical Temperature Printout

TMPVSC = 6720

SENSOR NUMBERS	LOCATION	DEGREES F
T73	SOLAR LOOP---OUTLET	57.0
T14	PUMPS 1A AND 1B DISCHARGE .	51.8
T15	HEAT EXCHANGER---SHELL OUT .	65.6
T16	HEAT EXCHANGER---SHELL IN . .	64.9
AVE T17,T18,T19	TANK 1	89.4
AVE T20,T21,T22	TANK 2	113.3
AVE T23,T24,T25	TANK 3	96.4
AVE T26,T27,T28	TANK 4	100.0
AVE T29,T30,T31	TANK 5	94.1
AVE T32,T33,T34	TANK 6	97.0
AVE T47,T48,T49	ASSEMBLY AIR TEMPERATURE . .	67.9
AVE T50,T51,T52	RUBBER AIR TEMPERATURE . . .	67.6
AVE T65,T66,T67	OFFICE AIR TEMPERATURE . . .	69.2
AVE T69,T70,T71	MACHIE SHOP AIR TEMPERATURE	68.4
T41 - T35	DT ASSEMBLY AIR HANDLER . .	12.8
T42 - T36	DT RUBBER AIR HANDLER . . .	1.4
T43 - T37	DT STOCKROOM AIR HANDLER . .	5.3
T44 - T38	DT MACHINE SHOP AIR HANDLER	2.9
T45 - T39	DT LOBBY AIR HANDLER	4.4
T46 - T40	DT LUNCHROOM AIR HANDLER . .	10.2

0 = TANKO→
0 = TANKI→

THE NUMBER PRECEEDING TANKO AND TANKI ARE THE RESPECTIVE TANK THAT WATER IS BEING USED TO HEAT THE BUILDING AND WATER IS BEING USED TO STORE HEAT. A ZERO(0) INDICATES THAT THIS PARTICULAR FUNCTION IS NOT IN OPERATION AT THIS TIME.

PROCEEDURES FOR MANUALLY OPERATING THE RKL SOLAR SYSTEM

As it is desirable at certain times to operate the system manually when computers are being serviced or maintenance is taking place in different parts of the system, we determined from the beginning that there would be a manual system for the basic collection, storage and distribution for both the heating and cooling modes.

To accomplish this manual operation a series of toggle switches were placed under a locked cover to the right of the operator at our solar computer console. These toggle switches allow us to bypass the computer at any time if the need arises. These switches are shown in picture plate No. 4.

The following computer printouts are instruction to an operator which are self-explanatory to handle any of the manual override that might be desired.

11-3-80

PROCEDURE FOR OBTAINING SYSTEM TEMPERATURES

1) TURN ON SIGNAL CONDITIONER FOR DISK DRIVES.
2) TURN ON LOWER CROMEMCO Z2 MICRO-PROCESSOR.
3) TURN ON LEAR SEIGLER ADM 3 CRT FOR DISPLAY.
4) INSERT DISK E9 INTO RIGHT HAND DISK DRIVE---
   LABEL FACING LEFT---LEFTMOST SLOT ON DRIVE.
5) PUSH RESET BUTTON ON LOWER CROMEMCO Z2 PROCESSOR.
6) PUT SWITCH, SECOND FROM BOTTOM ON LEFT SIDE
   OF OPTO-22 BOX IN THE UP POSITION.
7) PUSH THE RETURN BUTTON ON THE CRT KEYBOARD
   SEVERAL TIMES.
8) THE COMPUTER WILL PROMT THE USER WITH THE
   FOLLOWING PHRASE:

   ```
   CROMEMCO RDOS:
   ;
   ```

9) TO THIS THE USER SHOULD RESPOND WITH A B
   FOLLOWED BY A CARRIAGE RETURN.
10) THIS TIME, THE COMPUTER WILL RESPOND WITH THE
    FOLLOWING:

    ```
    CDOS VERSION 02.17
    CROMEMCO DISK OPERATING SYSTEM
    COPYRIGHT (C) 1978,1979 CROMEMCO, INC.

    A.
    ```

11) THE COMPUTER IS NOW READY TO EXECUTE A PROGRAM.
    THE ONLY PROGRAMS THAT IT CAN DIRECTLY EXECUTE, ARE
    THOSE WITH A FILENAME ENDING WITH A 'COM' EXTENSION.
12) TYPE IN LOOK3 AND FOLLOWED BY A CARRIAGE RETURN.
13) DISPLAY SHOULD APPEAR WITHIN 30 SECONDS.
14) TO MOMENTARILY HALT THE DISPLAY'S SCROLLING ACTION,
    A CONTROL-S CAN BE USED. THIS IS ACCOMPLISHED BY
    DEPRESSING THE CTRL KEY AND WHILE HOLDING THIS KEY,
    DEPRESSING THE S KEY.
15) TO ABORT THE DISPLAY USE A CONTROL-C. TO PRINT OUT
    THE DISPLAY USE A CONTROL-P.
16) RESTART DISPLAY BY TYPING A CONTROL-S AGAIN. TO STOP
    THE PRINTING OF THE DISPLAY, TYPE A CONTROL-P.

10-3-80

COLLECTING AND STORAGE LOOP INSTRUCTIONS

1) OPEN CV 125
2) OPEN SURGE TANK BALL VALVE
3) TURN ON PUMP 1A AND 1B
4) PUT ARRAYS IN THE COLLECT POSITION
5) WHEN T73 AND T14 ARE GREATER THAN 60 F OPEN CV 3 AND 4
6) CLOSE CV 125
7) OPEN CV 1,8,120,110,33,34,35,36,37,40,44,48,52,56
8) DETERMINE DESIRED TANK FOR STORAGE.
9) VALVE TO THAT TANK USING THE FOLLOWING VALVES
   A) TANK1 -- CV 9 & 11
   B) TANK2 -- CV 13 & 15
   C) TANK3 -- CV 17 & 19
   D) TANK4 -- CV 21 & 23
   E) TANK5 -- CV 25 & 27
   F) TANK6 -- CV 29 & 31
10) WHEN THE LOOP TEMPERATURE (IE.T13,T14, AND T73) IS GREATER THAN THE SELECTED TANK TEMPERATURE, TURN ON PUMP 2.
11) AT THE END OF THE DAY, OR WHEN CONDITIONS DICTATE (IE.SNOW, WIND, MECHANICAL PROBLEM, ETC.), THE FOLLOWING PROCEDURE SHOULD BE USED TO SHUTDOWN THE SYSTEM.
11) TURN OVER ARRAYS
12) TURN OFF PUMP 1A, 1B, AND 2
13) CLOSE CV 125,1,8,120,3,4,110,33,34,35,36,37,40,44,48,52,56
    9,11,13,15,17,19,21,23,25,27,29,31
14) CLOSE SURGE TANK BALL VALVE.

B.

10-3-80

HEATING OF PLANT AND OFFICES

1> DETERMINE SOURCE OF HEAT.
   IE. SOLAR LOOP OR STORAGE.

2> IF SOURCE IS SOLAR LOOP,
   A> OPEN CV 99,96,79,1,65,115,112
   B> CHECK AIR HANDLER INSTRUCTIONS TO DETERMINE AIR HANDLER VALVES THAT ARE TO BE OPENED.
   C> OPEN THOSE VALVES
   D> TURN ON PUMP 2.
   E> WHEN A COMFORTABLE TEMPERATURE HAS BEEN REACHED, SET UP MODE TO STORE SOLAR LOOP HEAT IN A TANK.

3> IF SOURCE IS TANK STORAGE,
   A> OPEN CV 33,34,30,66,59,55,51,47,43,38,41,45 49,53,57,63,72,74,91, AND 93.
   B> CHECK AIR HANDLER INSTRUCTIONS TO DETERMINE AIR HANDLER VALVES THAT ARE TO BE OPENED.
   C> OPEN THOSE VALVES
   D> DETERMINE TANK THAT IS DESIRED TO BE USED.
      1> TANK 1 OPEN CV 10 & 12
      2> TANK 2 OPEN CV 14 & 16
      3> TANK 3 OPEN CV 18 & 20
      4> TANK 4 OPEN CV 22 & 24
      5> TANK 5 OPEN CV 26 & 28
      6> TANK 6 OPEN CV 30 & 32
   E> OPEN THOSE VALVES FOR THE TANK DESIRED.
   F> TURN ON PUMP 3A AND 3B.
   G> WHEN A COMFORTABLE TEMPERATURE HAS BEEN REACHED, TURN OFF PUMP 3A AND 3B.

B.

AIR HANDLER CONTROL DIRECTIONS

THE AIR HANDLERS ARE TO BE SET UP IN THE FOLLOWING MANNER USING THEM FOR TANK TO AIRHANDLER HEAT AND SOLAR LOOP TO HEAT EXCHANGER TO AIR HANDLER PREHEAT MODES. THE VALVING TO THE AIR HANDLER BUSSES IS ACCOMPLISHED IN SHEET SETTING UP THE HEATING MODE DISTRIBUTION LOOP. THIS SHEET ONLY DESCRIBES THE SETTING OF THE VALVES ON THE AIR HANDLERS THEMSELVES.

THE AIR HANDLER VALVES CAN BE DESCRIBED IN THE FOLLOWING MANNER:

XX Y

XX -- THE TWO NUMBER VALVE PREFIX
Y -- THE ONE NUMBER VALVE SUFFIX

THE PREFIXES DETERMINE THE AIR HANDLER THAT IS BEING USED, AND THE SUFFIXES DETERMINE THE ACTUAL BANKS ON THAT AIR HANDLER THAT ARE BEING ACTIVATED, THESE ARE DIFFERENT WHETHER ONE IS USING THE PREHEAT OR HEAT MODE VALVE CHARTS.

THE BANK AND AIR HANDLER SELECTIONS FOLLOW:

AIR HANDLERS:

- 20Y -- ASSEMBLY
- 21Y -- RUBBER
- 22Y -- STORAGE
- 23Y -- MACHINE
- 24Y -- LOBBY
- 25Y -- LUNCHROOM

BANKS <PREHEAT MODE>:

- BANK1:XX1
- BANK2:XX1,XX4
- BANK3:XX1,XX4,XX5
- BANK4:XX1,XX4,XX5,XX6

BANKS <HEATING MODE>:

- BANK1:XX2
- BANK2:XX2,XX6
- BANK3:XX2,XX6,XX5
- BANK4:XX2,XX6,XX5,XX4

IN THE PREVIOUS INFORMATION, IT MUST BE RECOGNIZED THAT THE BANKS ARE ADDITIVE AND THAT BANK ONE MUST BE ACTIVATED BEFORE BANK TWO AND TWO BEFORE THREE AND SO ON; AND THAT THE TOTAL NUMBER OF BANKS TO BE ACTIVATED ON ANY INDIVIDUAL AIR HANDLER CANNOT EXCEED FOUR <4>.

EXAMPLES OF AIR HANDLER AND BANK SELECTION

EXAMPLE 1: THE AIR TEMPERATURE IN THE RUBBER AREA IS 63 F AND THERE HAVE BEEN NUMEROUS COMPLAINTS ABOUT IT BEING TOOOOOOOOOOOOOOOOOOOOO CCCCCCOLD. THE FIRST THING THAT HAS TO BE DONE IS TO DETERMINE WHICH TANK IS TO BE USED TO HEAT THE BUILDING. WHEN THIS IS DONE, THE OPERATOR MUST DETERMINE HOW MANY OF THE BANKS AND WHICH AIR HANDLER IS TO BE USED. THIS IS DONE BY CHECKING ON THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS.

FIRST, FIND THE TWO NUMBER VALVE PREFIX TO FIND THIS, ONE CHECKS THE AREA TITLED AIR HANDLERS. FROM THIS IT IS DETERMINED THAT THE PREFIX SHOULD BE 21 <21Y>.

SECOND, FIND THE ONE NUMBER VALVE SUFFIX<ES> NEEDED TO COMPLETE THE VALVE NUMBERS. ASSUME FOR NOW THAT THREE BANKS ARE NEEDED TO AFFECT A REASONABLE TEMPERATURE RISE IN THAT AREA. ONE NOW CHECKS THE TITLE BANKS <HEATING MODE>: AND FINDS THAT XX2,XX6,AND XX5 ARE NEEDED.

THIRD, THE OPERATOR COMBINES THESE NUMBERS IN THE FOLLOWING MANNER:

XXY

XX = 21
Y = 2,6, AND 5

SO THAT THE RESULTING VALVE NUMBERS ARE AS FOLLOWS:

212
216
215

B.

11-4-80

PROCEDURE FOR MANUAL CONTROL OF ARKLA CHILLERS

1) OPEN CV 13,11,120,8,1,110,5,6,33
2) TURN ON PUMP 1A AND 1B.
3) TURN UP ARRAYS
4) WAIT EXACTLY NINE (9) MINUTES
5) OPEN CV 9, CLOSE CV 13,33
6) OPEN CV 79,111,106,109,115,65
7) AFTER 20 SECONDS CLOSE CV 110 & 9
8) CLOSE CV 8,120,11
9) TURN ON BOILER
10) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 160 F
    A) OPEN CV 88,89,95,86,85,101,102
    B) SELECT AIR HANDLER VALVES TO BE OPENED FROM THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS AND THE PARTICULAR BANK OR BANKS THAT ARE TO BE USED FROM THE BANKS(HEATING MODE): AREA OF THE PAGE.
    C) TURN ON PUMP 5
11) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 165 F, TURN ON ARKLA 1 AND ARKLA 2.

    NOTE: PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF THE CHILLERS ARE RUN AT LOWER THAN 160 F HOT WATER INLET TEMPERATURES.
    THIS DAMMAGE WILL BE CAUSED IMMEDIATELY BECAUSE OF THE NATURE OF THE EQUIPMENT.
    THE OPERATOR SHOULD KEEP THIS IN MIND WHEN OPERATING THIS EQUIPMENT!!!!!!!!!

12) WHEN COLLING IS NO LONGER NEEDED;
    A) TURN OFF ARKLAS
    B) WAIT 2 MINUTES (IMPORTANT)
    C) TURN OFF BOILER
    D) OPEN CV 9,11,120,110,8
    E) CLOSE CV 65,79,111,106,102,101,115
    F) TURN OVER ARRAYS
    G) OPEN CV 15,40; CLOSE CV 11
    H) AFTER EXACTLY NINE (9) MINUTES
        1) TURN OFF PUMP 1A AND 1B
        2) CLOSE CV 15,40,9,110,8,120,1,5,6
    I) TURN OFF PUMP 5
    J) CLOSE CV 88,89,95,86,85,AND ALL AIR HANDLER VALVES. (IE. THOSE OF THE 200 SERIES)

PROCEDURE FOR STORAGE OF CHILLED WATER

1) OPEN CV 13,11,120,3,1,110,5,6,33
2) TURN ON PUMP 1A AND 1B.
3) TURN UP ARRAYS
4) WAIT EXACTLY NINE (9) MINUTES
5) OPEN CV 9, CLOSE CV 13,33
6) OPEN CV 79,111,106,109,115,65
7) AFTER 20 SECONDS CLOSE CV 110 & 9
8) CLOSE CV 3,120,11
9) TURN ON BOILER
10) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 160 F
    A) OPEN CV 88,89,90,93,78,68,48,52,56,35,36,37
    ,58,70,74,84,86
    B) CHOOSE TANK VALVES FROM THE FOLLOWING LIST:

        1) TANK 3: CV 17 & 19
        2) TANK 4: CV 21 & 23
        3) TANK 5: CV 25 & 27
        4) TANK 6: CV 29 & 31

    C) TURN ON PUMP 5
11) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 165 F, TURN ON ARKLA 1 AND ARKLA 2.

    NOTE: PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF THE CHILLERS ARE RUN AT LOWER THAN 160 F HOT WATER INLET TEMPERATURES.
    THIS DAMMAGE WILL BE CAUSED IMMEDIATELY BECAUSE OF THE NATURE OF THE EQUIPMENT.
    THE OPERATOR SHOULD KEEP THIS IN MIND WHEN OPERATING THIS EQUIPMENT!!!!!!!!!

12) WHEN COLLING IS NO LONGER NEEDED:
    A) TURN OFF ARKLAS
    B) WAIT 2 MINUTES (IMPORTANT)
    C) TURN OFF BOILER
    D) OPEN CV 9,11,120,110,3
    E) CLOSE CV 65,79,111,106,102,101,115
    F) TURN OVER ARRAYS
    G) OPEN CV 15,40; CLOSE CV 11
    H) AFTER EXACTLY NINE (9) MINUTES
        1) TURN OFF PUMP 1A AND 1B
        2) CLOSE CV 15,40,9,110,3,120,1,5,6
    I) TURN OFF PUMP 5
    J) CLOSE CV 88,89,90,93,78,68,48,52,56,35,36,37,
    58,70,74,84,86,17,19,21,23,25,27,29,31

11-4-80

DISTRIBUTION OF CHILLED WATER FROM TANK TO AIR HANDLERS

1) DETERMINE IF THE TEMPERATURE IN A TANK IS LESS THAN THE AIR TEMPERATURE IN THE BUILDING BY TWENTY OR MORE DEGREES F. IF THERE IS SUFFICIENT DIFFERENTIAL TEMPERATURE, PROCEED.
2) OPEN CV 41,45,49,53,57,33,43,47,51,55,63,68,80,92,93, 84,85,74,70,59
3) CHOOSE TANK VALVES FOR USE OF STORED WATER IN A TANK. IN THE FOLLOWING CHART, ONE CAN DETERMINE THE VALVES THAT IT WOULD BE NECESSARY TO OPERATE IN ORDER TO UTILIZE THE THAT TANK WHICH WAS CHOSEN.

   A) TANK 1 OPEN CV 10 & 12
   B) TANK 2 OPEN CV 14 & 16
   C) TANK 3 OPEN CV 18 & 20
   D) TANK 4 OPEN CV 22 & 24
   E) TANK 5 OPEN CV 26 & 28
   F) TANK 6 OPEN CV 30 & 32

4) CHOOSE AIR HANDLER VALVES THAT ARE TO BE OPERATED. THIS IS DONE BY CHECKING ON THE PAGE TITLED "AIR HANDLER CONTROL DIRECTIONS". THE ACTUAL BANKS CAN BE FOUND BY USING THE SECTION TITLED "BANKS (PREHEAT MODE):".
5) AFTER ALL VALVE SETTINGS HAVE BEEN ACCOMPLISHED, PUMPS 3A AND 3B CAN BE ACTIVATED.
6) WHEN THE TANK HAS BEEN EXHAUSTED, OR THE PLANT HAS BECOME COOL ENOUGH, TURN OFF PUMP 3A AND 3B, VALVE TO A NEW TANK OR CLOSE DISTRIBUTION VALVES AS THE CASE MAY BE.

B

11-4-80

PROCEDURE FOR MANUAL OPERATION OF AUXILIARY COOLING

1) OPEN CV 12,116,114,109,111,106
2) TURN ON PUMP 1A AND PUMP 1B.
3) TURN ON AUXILIARY WATER HEATER
4) WHEN T55 AND T56 ARE BOTH GREATER THAN 160 F:
   A) OPEN CV 88,89,95,86,85,101,102
   B) SELECT AIR HANDLER VALVES TO BE OPENED FROM THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS AND THE PARTICULAR BANK OR BANKS THAT ARE TO BE USED FROM THE BANKS(HEATING MODE): AREA OF THE PAGE.
   C) TURN ON PUMP 5
5) WHEN T55 AND T56 ARE BOTH GREATER THAN 165 F, TURN ON ARKLA 1 AND ARKLA 2.

   NOTE: PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF THE CHILLERS ARE RUN AT LOWER THAN 160 F HOT WATER INLET TEMPERATURES. THIS DAMMAGE WILL BE CAUSED IMMEDIATELY BECAUSE OF THE NATURE OF THE EQUIPMENT. THE OPERATOR SHOULD KEEP THIS IN MIND WHEN OPERATING THIS EQUIPMENT!!!!!!!!!

6) WHEN COOLING IS NO LONGER NEEDED:
   A) TURN OFF ARKLAS
   B) WAIT 2 MINUTES (IMPORTANT)
   C) TURN OFF AUXILARY WATER HEATER
   D) TURN OFF PUMPS 1A AND 1B.
   E) CLOSE CV 12,116,114,109,111,106
   F) TURN OFF PUMP 5
   G) CLOSE CV 101,102,88,89,95,86,85, AND ALL AIR HANDLER VALVES. (IE. THOSE OF THE 200 SERIES)

MAINTENANCE BULLETIN FOR RKL DESIGNED SOLAR COLLECTING SUB-ARRAY

1. Twice yearly at the time of changeover from water to propolene glycol or from propolene glycol to water in the early spring or late fall the one horse power one rpm, double reduction gear motor should be checked for lubricant level.

2. Twice a year the oil cups on the top of the bearing at either end of the sub-array shaft should be checked for grease capacity.

3. The safety releif valves located on the collector discharge header should be checked for pressure setting and ease of operation and tight sealing at least twice a year.

4. Check all tie-down bolts on each leg of the A-frame support once a year for tightness of the hold-down clamps.

5. Check the drive chain from the gear motor drive to the shaft for lubrication twice a year. It should be lubricated with a heavy molly-type sprayon lubricant.

6. Check all hose connections for possible leakage and deterioration at least once a week.

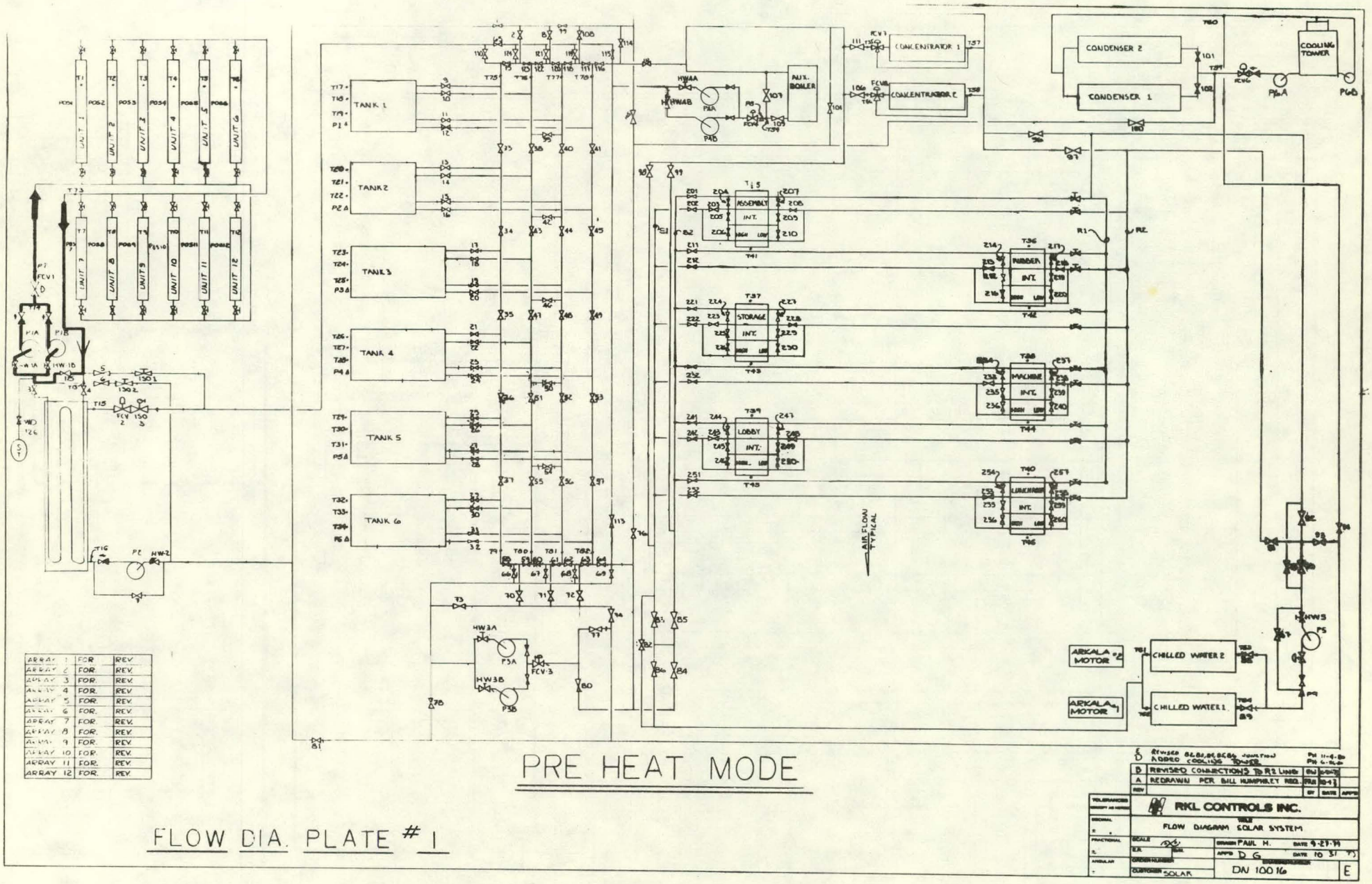
7. Check and repair insulation of the two inch diameter hose from each header to each collector loop for fraying and cutting, and repair once every fall.

8. Check the keyway on the drive motor shaft and the spurgear lockset every four months for tightness.

9. Clean collector glass twice a year during switch over from heating to cooling and cooling to heating.

Typical Operation Modes

Heating Season	Flow Dia. Plate #
Pre Heat Mode	1
Solar Collection to Storage	2
Storage to Plant Air Handling Units	3
Auxillary to Storage	4
Cooling Season	
Solar Collection to Hot Storage	2
Hot Storage to Chillers	5
Chillers to Storage	6
Chillers to Plant Air Handling Units	7
Hot Auxillary to Chillers	8
Solar Collection to Chillers	9



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

PRE HEAT MODE

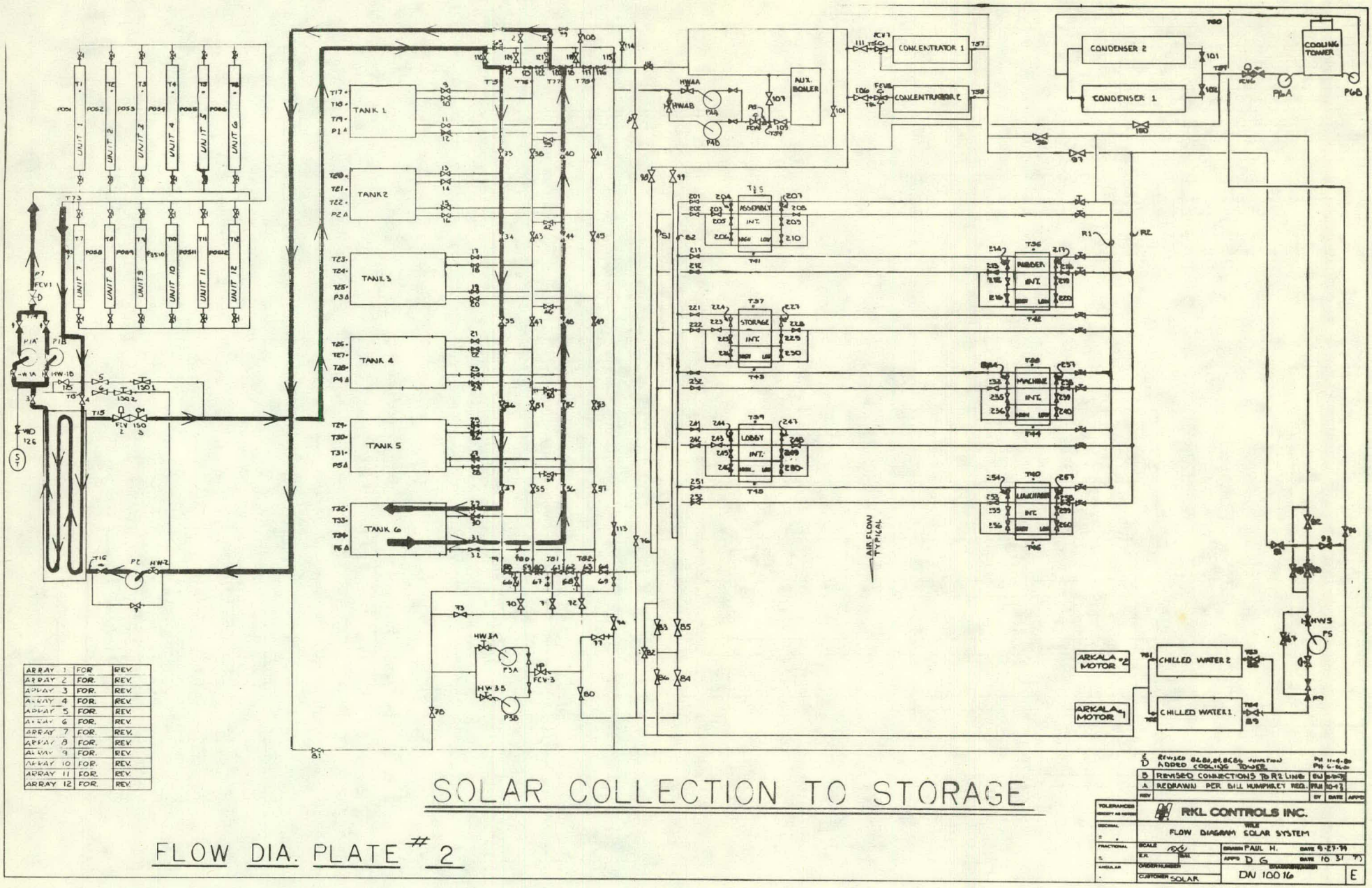
FLOW DIA. PLATE #1

REV		BY	DATE	APPD
D	REVISED CONNECTIONS TO R2 LINE	BW	5-8-84	
A	REDRAWN PER BILL HUMPHREY REQ.	PAH	10-1-83	

RKL CONTROLS INC.

FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 9-27-79
APPD D.G. DATE 10-31-79
DWG NO. DN 100 16
SIZE E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

SOLAR COLLECTION TO STORAGE

FLOW DIA. PLATE # 2

REV		BY	DATE	APPD
D	Revised 84,85,86,86A Added CCW-1,2,3		PH 11-4-85 PH 6-26-86	
B	REVISED CONNECTIONS TO R2 LINE	BW	5-9-84	
A	REDRAWN PER BILL HUMPHREY REQ.	PAH	10-9-83	

RKL CONTROLS INC.

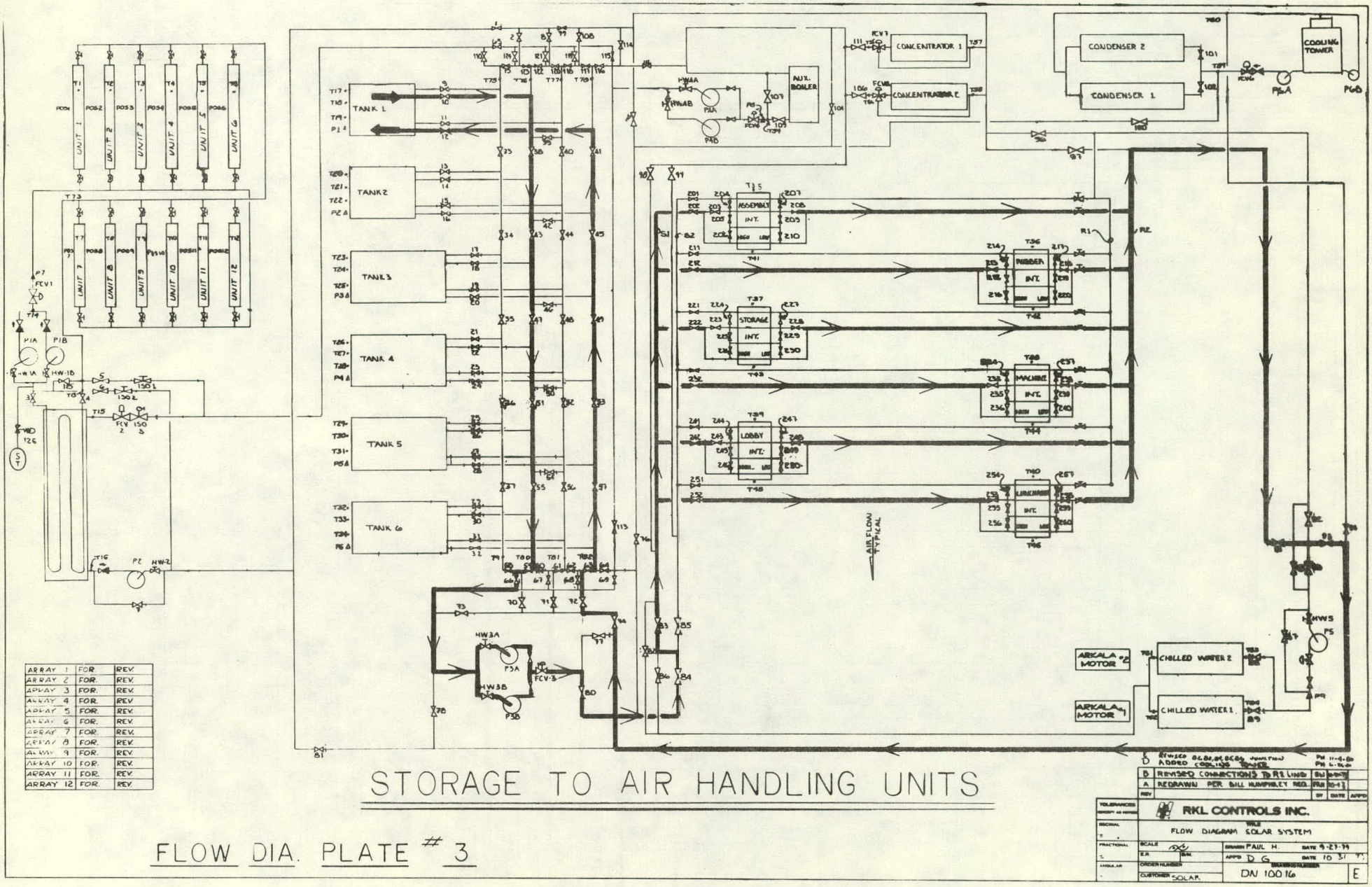
TITLE: FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 4-29-83

APPD D.G. DATE 10 31 83

CUSTOMER SOLAR

DWG NO 10016 E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

STORAGE TO AIR HANDLING UNITS

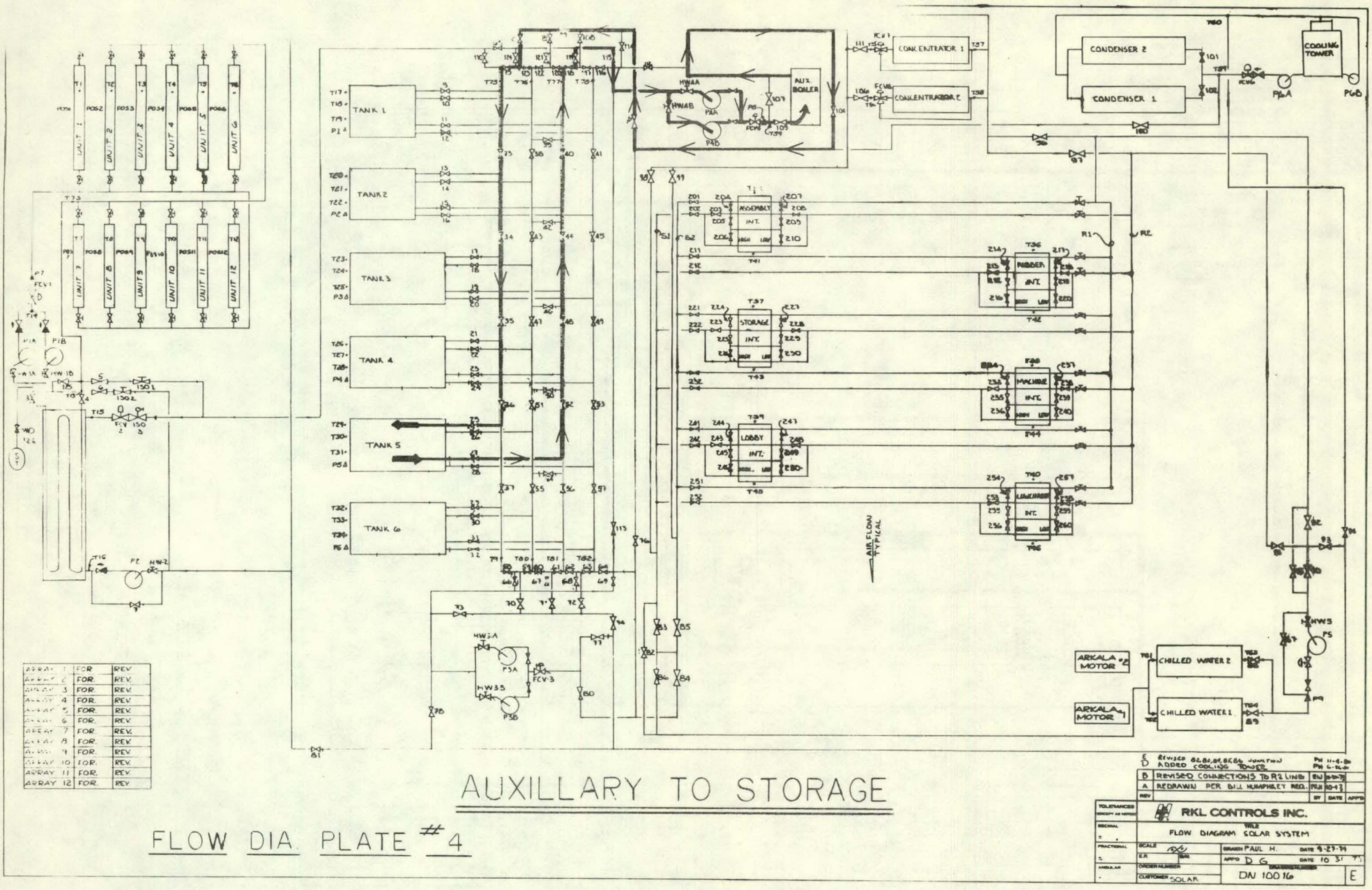
FLOW DIA. PLATE # 3

REV		BY	DATE	APPD
D	REVISED CONNECTIONS TO R1 LINE	BW	10-3-79	
A	REDRAWN PER BILL HUMPHREY REQ.	PAH	10-1-79	

RKL CONTROLS INC.

FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 9-27-79
APPD D G DATE 10 31 79
SCALE NONE
ORDER NUMBER
CUSTOMER SOLAR
DRAWING NUMBER DN 10016 E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

AUXILLARY TO STORAGE

FLOW DIA. PLATE #4

E	REVISED 84,86,87,88,89 JUNCTION ADDED COOLING TOWER	PW	11-6-86 PW 6-15-87	
D	REVISED CONNECTIONS TO R1 & R2 LINES	BW	10-3-86	
A	REDRAWN PER BILL HUMPHREY REQ.	PW	10-1-86	
REV		BY	DATE	APPD

RKL CONTROLS INC.

TITLE: FLOW DIAGRAM SOLAR SYSTEM

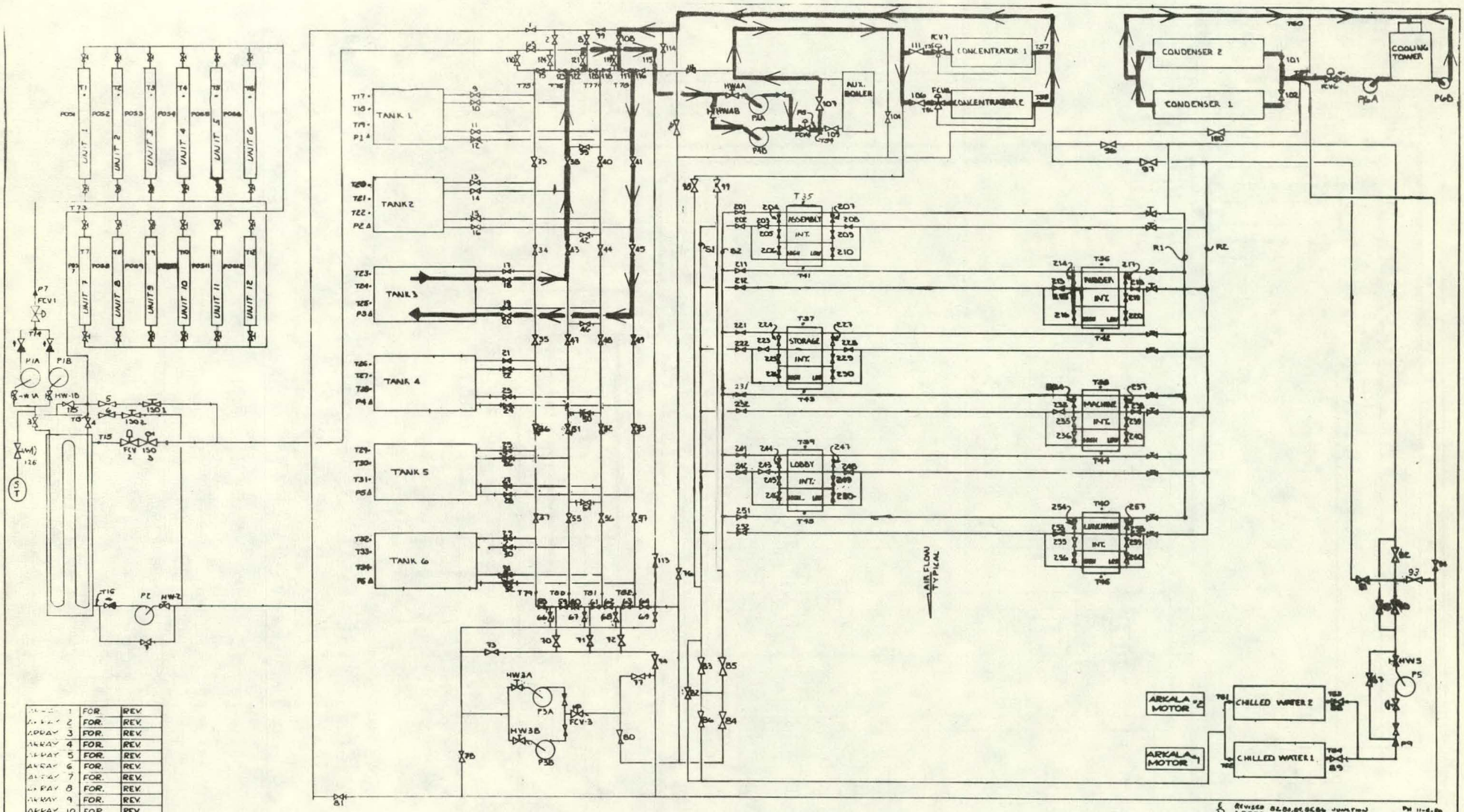
DRAWN PAUL H. DATE 9-27-84

APPD D G DATE 10 31 84

ORDER NUMBER

CUSTOMER SOLAR

DRAWING NUMBER DN 10016 E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

HOT STORAGE TO CHILLERS

FLOW DIA. PLATE #5

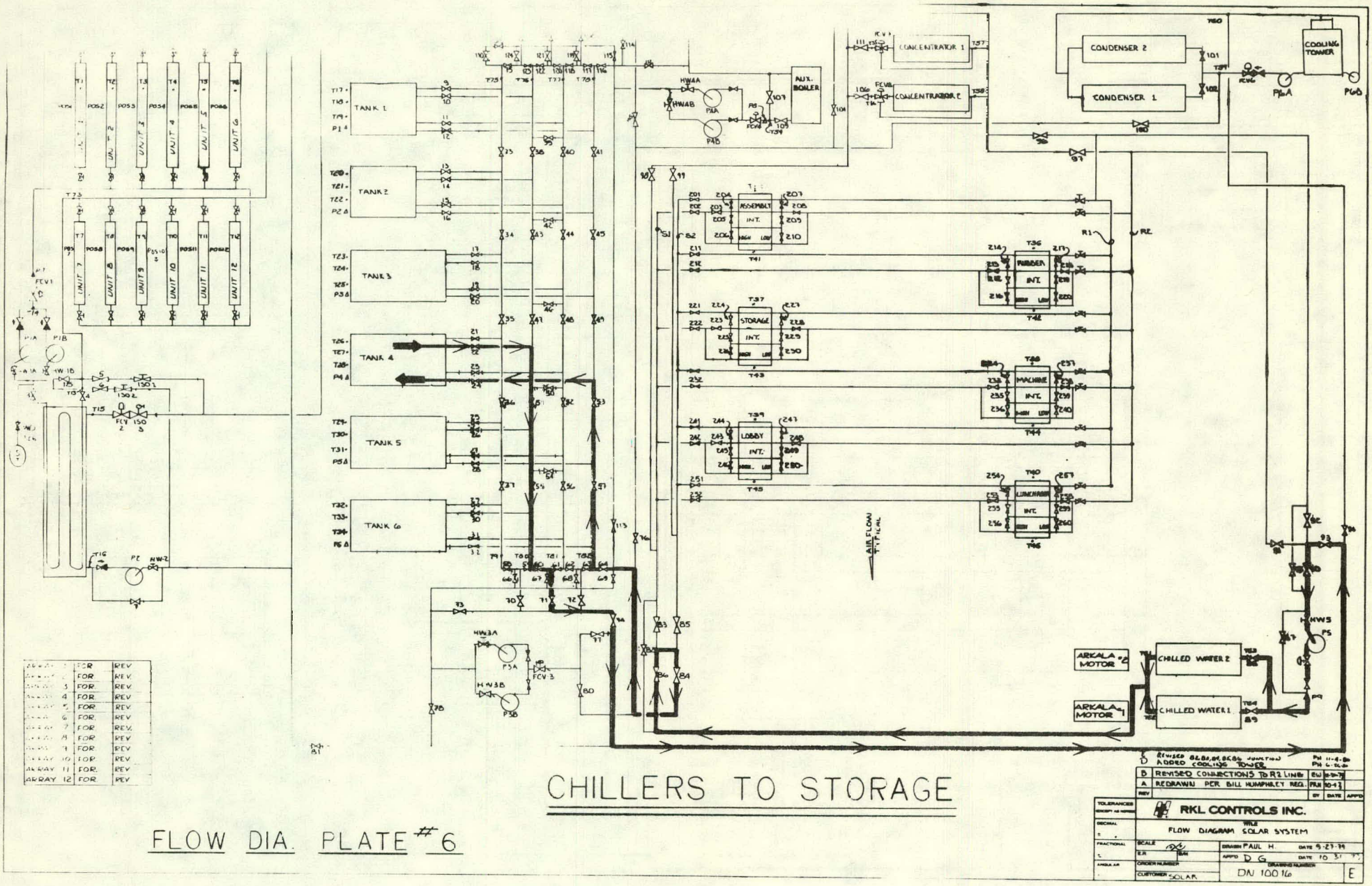
REV		BY	DATE	APPD
D	REVISED P2,P3,P5,P6 & FLOW ADDED COOLING TOWER		PH 11-4-80 PH 6-24-80	
C	REVISED CONNECTIONS TO R2 LINE	DU	8-29-79	
B	REDRAWN PER BILL HUMPHREY REQ.	PH	10-1	

RKL CONTROLS INC.

TITLE: FLOW DIAGRAM SOLAR SYSTEM

SCALE: 1/16" FULL | DRAWN PAUL H. DATE 9-27-79 | APPD D.G. DATE 10 31 79

CUSTOMER SOLAR | DN 10016 | E



CHILLERS TO STORAGE

FLOW DIA. PLATE #6

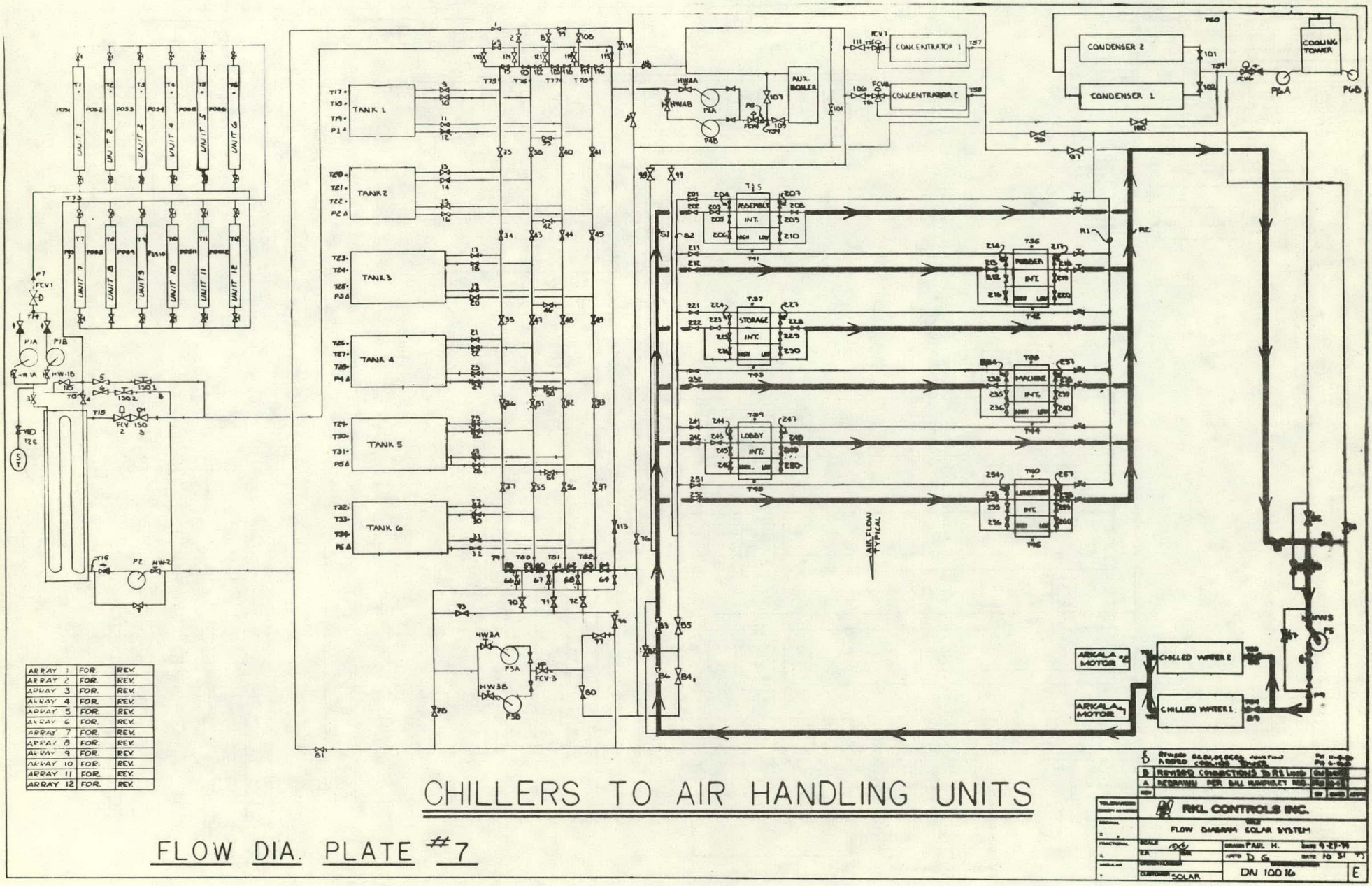
ARRAY 1	FOR	REV
ARRAY 2	FOR	REV
ARRAY 3	FOR	REV
ARRAY 4	FOR	REV
ARRAY 5	FOR	REV
ARRAY 6	FOR	REV
ARRAY 7	FOR	REV
ARRAY 8	FOR	REV
ARRAY 9	FOR	REV
ARRAY 10	FOR	REV
ARRAY 11	FOR	REV
ARRAY 12	FOR	REV

REV		BY	DATE	APPD
D	REVISED GLOBAL BCBS JUNCTION ADDED COOLING TOWER		PH 11-6-80 PH 6-26-80	
B	REVISED CONNECTIONS TO R2 LINE	EW	8-27-79	
A	REDRAWN PER BILL HUMPHREY REQ.	PRH	10-1-79	

RKL CONTROLS INC.

TITLE: FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 9-27-79
APPD D G DATE 10 31 79
ORDER NUMBER
CUSTOMER SOLAR
DRAWING NUMBER DN 10016 E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

CHILLERS TO AIR HANDLING UNITS

FLOW DIA. PLATE #7

D	REVISED CONNECTIONS TO R.E. Ltd.
A	REDRAWN PER BILL HUMPHREY

RKL CONTROLS INC.

FLOW DIAGRAM SOLAR SYSTEM

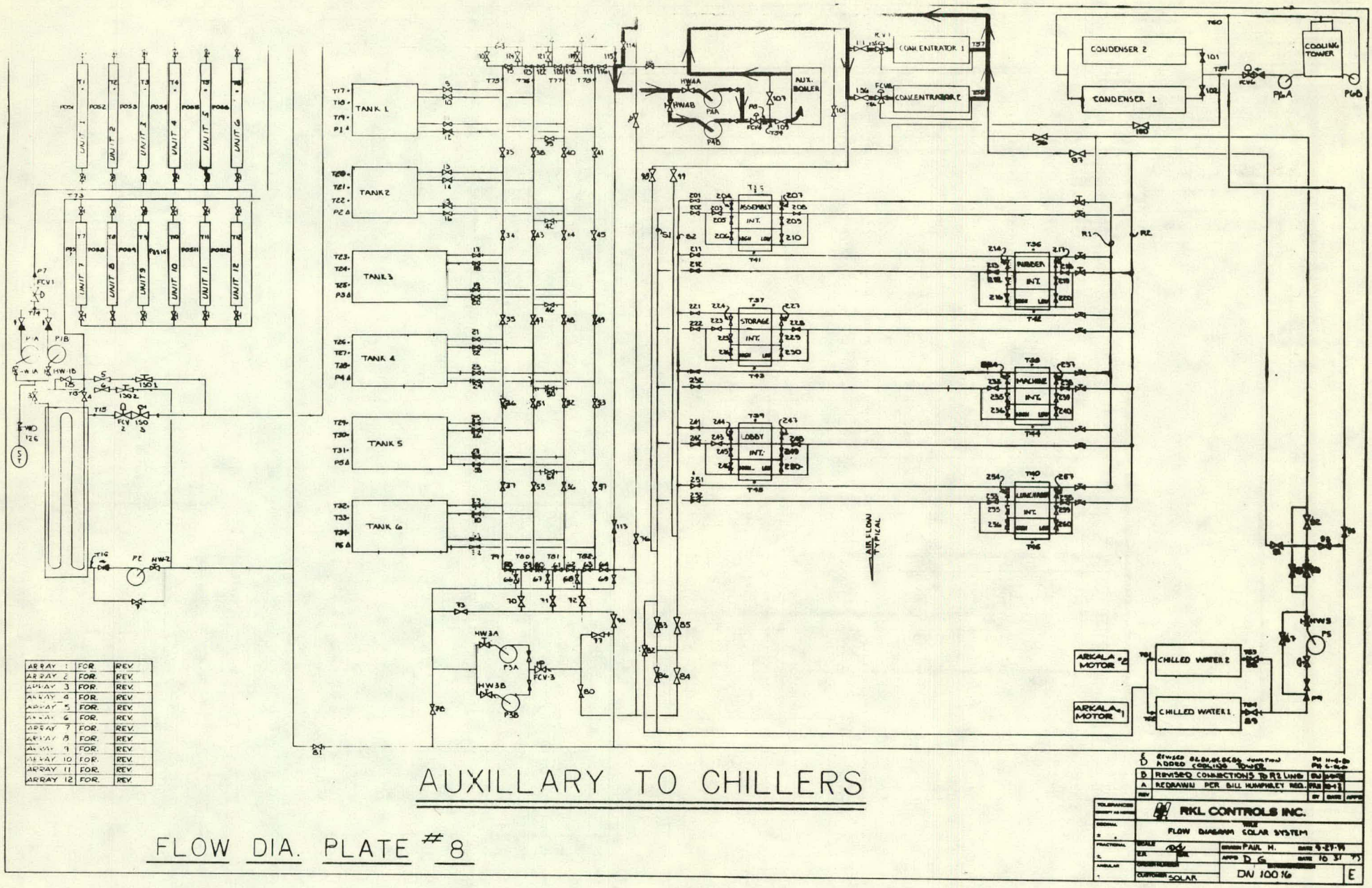
DRAWN PAUL H. DATE 9-27-79

APPD D.G. DATE 10 31 79

CUSTOMER SOLAR

DN 100 16

E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

AUXILLARY TO CHILLERS

FLOW DIA. PLATE #8

REV		BY	DATE	APPD
D	REVISED CONNECTIONS TO R3 LINE	BW	6-27-79	
A	REDRAWN PER BILL HUMPHLEY REQ.	PAS	10-1-79	

RKL CONTROLS INC.

TITLE: FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 9-27-79

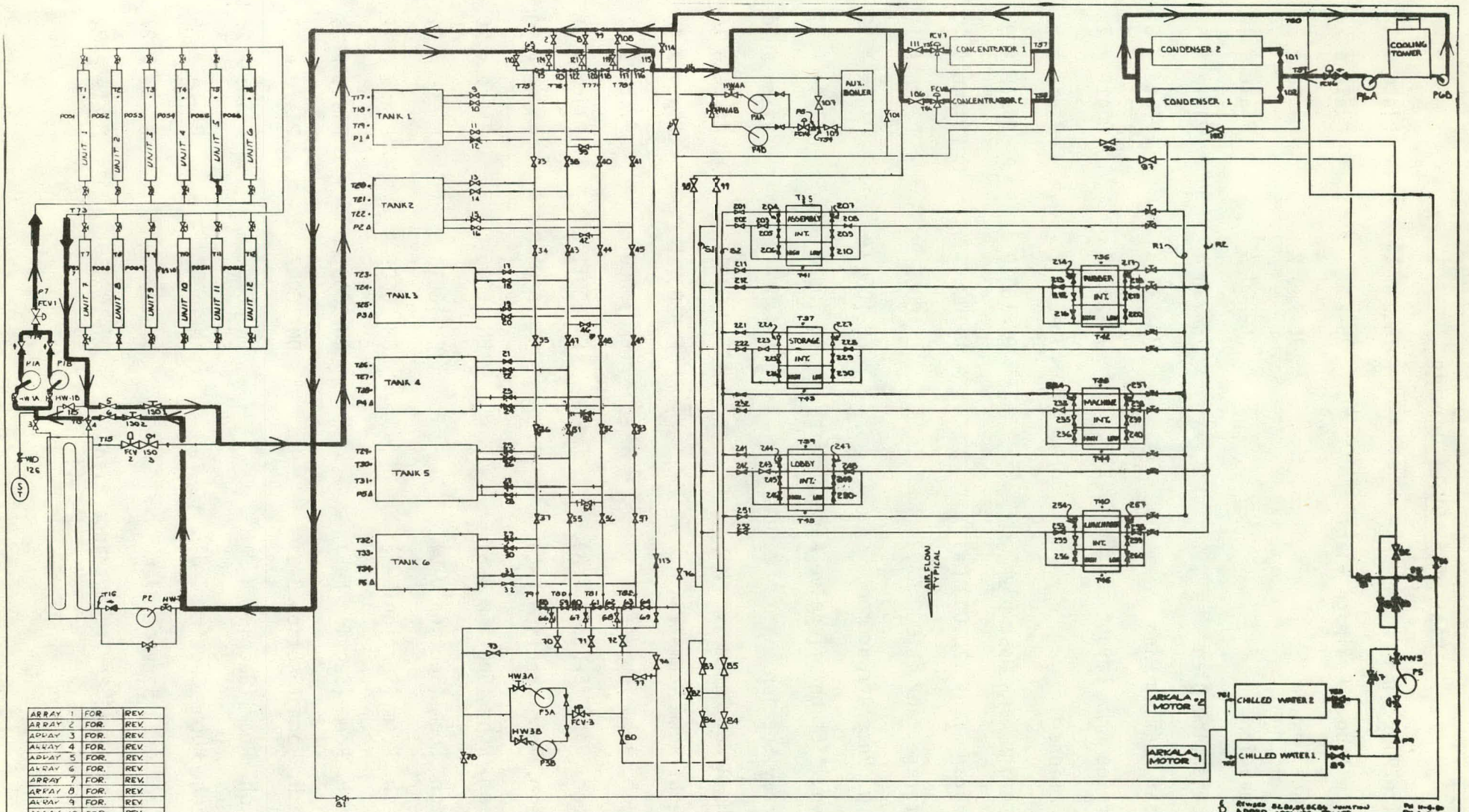
APPD D.G. DATE 10 31 79

SCALE

CUSTOMER SOLAR

DWG NO 1001G

SIZE E



ARRAY 1	FOR.	REV.
ARRAY 2	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

SOLAR COLLECTION TO CHILLERS

FLOW DIA. PLATE #9

D	REVISED CONNECTIONS TO P2 LOOP		
A	REDRAWN PER BILL HUMPHREY RED.		
REV			

RKL CONTROLS INC.

FLOW DIAGRAM SOLAR SYSTEM

DRAWN PAUL H. DATE 6-27-79

APPD D.G. DATE 10 31 79

COMPANY SOLAR

DW 10016 E

List of AS BUILT Drawings

Plant Site Plot Plan	75-230 1	Plate # 1
Plant Site Topo & Drainage Plan	75-230 1-A	Plate # 2
Plant Floor Plan	75-230 2	Plate # 3
Plant Elevation	75-230 3	Plate # 4
Plant Foundation Plan	75-230 4	Plate # 5
Plant Roof Framing Plan	75-230 5	Plate # 6
Plant Office Area Layout	75-230 6	Plate # 7
Plant Sections	75-230 7	Plate # 8
Solar Storage Tank Assembly	DN-10010	Plate # 9
Solar Storage Tank (10,000 Gal.)	D-10006	Plate # 10
Solar Storage Tank (5,000 Ga.)	C-10005	Plate # 11
Solar Typ. Pump Arrangement	DN-100097	Plate # 12
Solar Typ. "SG" on/off Valve Arrangement	BN-10026	Plate # 13
Solar Array Section	L-A-HW-AC-140	Plate # 14
Solar Sub-Array Assembly	S-H-03-15-7	Plate # 15
Solar Mech. Room Isometric	E 51002 E	Plate # 16
Solar Mech. Room Top View	EN 10000 c	Plate # 17
Solar Mech. Room (Section A-A)	EN 10011 C	Plate # 18
Solar Mech. Room (section C-C)	DN-10003-B	Plate # 19
Solar Mech. Room (Section B-B)	EN-10006-C	Plate # 20
Solar Mech. Room (Section D-D)	CN-10013-B	Plate # 21
Solar Mech. Room (Section E-E)	CN-10009-A	Plate # 22
Solar Mech. Room (Section F-F)	CN-10008-B	Plate # 23
Solar Mech. Room (Section G-G)	DN-10007-A	Plate # 24
Solar Mech. Room (Section H-H)	DN-10004-A	Plate # 25
Solar Mech. Room (Section J-J)	CN-10002	Plate # 26
Plant Electrical Service Plan	DN-100099	Plate # 27
Plant Electrical Service Entrance Plan	DN-100098	Plate # 28

List of AS BUILT Drawings (cont'd).

Plant Electrical Layout Plan	E-1	Plate #29
Plant & Berm Electrical Layout Plan	E-2	Plate #30
Solar Plant Piping & AHV Plan	EN-10012	Plate #31
Solar Collection Piping Loop Plan	EN-10005	Plate #32
Solar Loop Pre Heating Computer Floor Dia.	DN-10032	Plate #33
HMZ-Tanks To Air Handlers	DN-10033	Plate #34
Solar Computer Block Dia.	BN-10034	Plate #35
Solar Computer Input/Output Table	DN-10045	Plate #36
Piping Schematic	DN-10016	Plate #37

BLOCK 36, LOT 13
N/F L.C. JONES

N 76°-51'-31" E 1597.25

TRUE NORTH

ALL OPEN AREAS TO BE SEEDED

AREA = 8.8629 Acres = 386,069.88 SQ. FT.

AREA = 2.4657 Acres = 107,413.5 SQ. FT.

N 73° 48' 22" E 690.42

N 16° 11' 38" W 942.15'

LINE PARALLEL TO ARK RD.

BLOCK 38 LOT 4
N/F L.C. JONES & L.C. JR.
& E. JONES

POLE "A60174"

POLE "A60358LT"

POLE "A60358RT"

ENTR. CURB DETAIL
SCALE 3/4"=1'-0"

PARK'G LOT CURB DETAIL
SCALE 3/4"=1'-0"

ARK ROAD (49.5 WIDE)

966.93'

875.36'

197.00'

100.0'

84.0'

N 06° 15' 00" E

Roof Slope

Shipping & Receiving

Shipping (Receiving "Tailgate")

Existing Building

Concr. Curb

Grass

Evergreen Shrubs

7' Chain Link Fence

6' Panel Array

200'

Gates

Concr. Walk

Parking Area

Entrance Paving

Limits Gutter

Sign

Fire Hydrant

Cooling Pond
1½ Acres±

Concr. Spillway

STREAM ENCROACHMENT
LINE - 100 YR. FLOOD
ELEV. 39.0'

EXISTING WOODED AREA TO REMAIN

MASON'S CREEK

BLOCK 36, LOT 10E
N/F TRIANGLE AIRWAYS, INC.

N 04° 37' 21" E 201.07'

S 81° 52' 39" E 134.42'

30' WIDE EASEMENT TO L.C. JONES

N 27° 39' 09" E 208.41'

N 32° 14' 05" E - 152.44'

N 38° 02' 15" E - 33.00'

N 40° 58' 08" E - 151.36'

N 38° 22' 54" E 114.84'

N 22° 21' 45" E 79.84'

N 21° 28' 52" E - 49.32'

N 14° 41' 32" E - 86.44'

N 20° 13' 47" E - 113.52'

BLOCK 36, LOT 10E
N/F TRIANGLE AIRWAYS, INC.

BLOCK 36, LOT 10C
N/F A.C. MACK

BLOCK 38, LOT 6
N/F C.&P. THALWITZER

POLE "61742"

POLE "A60358LT"

POLE "A60358RT"

STOP SIGN

POLE "A7328"

N 10,000

E 10,000

SIGHT TRIANGLE

DIRECTION OF TRAFFIC

200.0

POLE "A60358"

N 76° 41' 31" E 343.39'

POLE "806/45" O (DISCONNECTED)

(900.00' CH. TO CH.)

N 76° 41' 31" E 571.44'

STACY HAINES ROAD (49.5 WIDE)

972.18'

STOP SIGN

BLOCK 39, LOT 1
N/F A.A. & L. CARLINO

BLOCK 37, LOT 9
N/F D.C. & V. KINTZING

POLE "SWP 11-73 SEP 3-40 43"

POLE "SWP 11-73 SEP 3-40"

POLE "SWP 11-73 SEP 3-40 42"

POLE "SWP 11-73 SEP 3-40"

POLE "A60358"

BLOCK 37, LOT 7
N/F INDEL CORP.

Legend

D.S. = Downspout
C.B. = Catch Basin

"A" Light Fix. = Pole Mounted 400 W. Metal Halide w/ 360 V. Ballast - 25' STD. Duty Alum. Pole w/ 2-24" Arms - Mounted on 18" Sq. Conc. Base 24" Above Grade & 36" Below.

"B" Light Fix. = Wall Mounted 400 W. Mercury Vapor - 208 V. Ballast

Conduit to be 1" PVC H.W. Conduit w/ 2-#8 & 1-#12 G. - Duct 24" Deep.

Survey Information Taken From Dwg. Dated 4-1-77 Revs. 6-2-77 By Atkinson & Walton, Civil Engrs.

Block 36, Lot 13.8
R.K.L. Controls Inc.
Area = 30.5086 Acres
= 1,320,242.60 Sq. Ft.
Building Area = 40,000 Sq. Ft.
Lot Coverage = 3.03 %
Zoning Class I-1 General Indus.

Notes:
See Sht. 1A for Topo & Drainage.

Sight Triangle Easement Subject to Grading, Planting & Construction Restrictions as Provided for in the Ezoning Ordinance of the Twp. of Lumberton.

Chain Link Fence to be Green Vinyl Coated.

Shade Trees to be Red Oak, 2" Caliper & 10' Ht. @ Plants.

Evergreens to be "Arborvitae" Maintained at 10'-12' High.

Concrete for Curbs & Walks to be 4000 PSI-28 Days.

This Plan is Hereby Approved by the Burlington Co. Planning Board 12 VIII-1977 Subject to the Restrictions, Agreements, and Conditions Set Forth by the Burl. Co. Plan. Bd.

By _____ Date _____

Paving Specs.

Roads & Loading Area
Base Course of 6"-2" Layers (4" Total) of Bituminous Stabilized Base
Wearing Surface of 2" Compact Bituminous Conc. (P.A.C.)

Parking Area
5" Base Course
1½" Wearing Surface

Parking Area to be Striped with White Paint - 4" Wide.

PLOT PLAN
SCALE 1" = 50'

LETTERING BOTH SIDES

RKL CONTROLS SOLAR PROJECT

5'-0"

4'-0"

4'-0"

SIGN DETAIL

KEY PLAN

Lumberton Twp.

Mt. Laurel Twp.

Medford Twp.

Planning Bd. Chairman _____ Date _____

Planning Bd. Secretary _____ Date _____

Approved by Planning Board _____

Rev. 11-11-77

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON, NJ

PAULL ENGINEERING
498 N. KINGS HIGHWAY
CHERRY HILL NJ 08034

Plot Plan

Dwg. No. 1

T.C.D.

BLOCK 38, LOT 4
N/F L.C. JONES & L.C. JR. & E. JONES

BLOCK 38, LOT 1
N/F L.C. JONES

N 76°-28'-30" E 1397.28'

NEW WOODED AREA

BLOCK 36, LOT 10E
N/F TRIANGLE AIRWAYS, INC.

N 64°-52'-E 701.07'

N 27°-31'-00" E 208.81'

N 32°-16'-08" E - 152.46'

N 38°-02'-15" E - 33.00'

N 40°-56'-08" E - 118.34'

N 35°-22'-54" E 119.84'

EXIST'G. WOODED AREA TO REMAIN

N 26°-01'-45" E 75.38'

MASON'S CREEK

BLOCK 36, LOT 10E
N/F TRIANGLE AIRWAYS, INC.

N 21°-26'-55" E - 69.96'

N 14°-41'-32" E - 86.44'

N 20°-13'-47" E - 113.52'

BLOCK 36, LOT 10D
N/F A.C. MACK

ROOF SLOPE

TYPE 'E' INLET ELEV. 46.5'

SHIPPING & RECEIVING (TRAILERS)

BLACK TOP PAVING

PARKING FOR 30 CARS

CURB CUTS @ 25'

DRIVEWAY

ARK ROAD (49.5 WIDE)

INV. EL. 38.0 - PROVIDE 6'-1"H. RIPRAP 8'-0" WD. & 18' L.G. AT OUTFALL

COOLING POND 1½ ACRES ±

WATER LEVEL EL. 38.0'

BOTTOM ELEV. AT CENTER 23±

12" THK. RIP RAP SPILL WAY STABILIZATION

STREAM ENCROACHMENT LINE 100 YR. FLOOD ELEVATION 39.0

EXIST'G. WOODED AREA TO REMAIN

SWALE AREA TO BE RODDED (8' WIDE)

SEEDED AREA

FLOW

EL. 48.6'

STACY HAINES ROAD (49.5 WIDE)

972.18'

EL. 41.9'

BLOCK 39, LOT 1
N/F A.A. & L. CARLINO

BLOCK 37, LOT 9
N/F D.C. & V. KINTZING

BLOCK 37, LOT 7
N/F INDEL CORP.

EVERGREENS SCOPED BANKS

10' TO 14'

12' STONE BASE

10' TO 12' SHRUBS

SECTION THRU "BERM"

HAND TAMPED BACKFILL

2" SALT HAY

PERFORATED PIPE WRAPPED JOINTS W/ 3" WIDE ASPHALT IMPREG. FELT STRIP

6" CRUSHED No. 1 STONE

4'-0"

1'-6"

SECTION AT DISPOSAL FIELD

DISPOSAL BED 32'-0" x 32'-0"

CONC. DISB. BOX INLET EL. 47.3

PIPE INV. AT ELBOW EL. 44.0'

4"ø PERF. TILE

SLOPE = 3"/100'

CLEANOUT EL. 47.0

1500 GAL. SEPTIC TANK

INV. 47.0'

INV. 41.8'

INV. 41.0'

4" C.I. SAN.

SEWAGE EJECTOR - PUMP TO BE 4'-3" STEEL CONFORMING TO STD. CUSTOMARY PRACTICE & ALL CODE REQUIREMENTS.

11'-0"

ENLARGED PLAN OF SEPTIC SYSTEM

SCALE 1" = 10'

REQ'D. AREA = 0.77 × 1500 GAL./DAY = 0.77 × 1500 = 1155 SQ. FT.
USE DISPOSAL FIELD 32'-0" × 32'-0" = 1325 SQ. FT.

PLOT PLAN

SCALE 1" = 50'

EL. 48.0'

GRASS BANK

3

INV. AT ELEV. 38.0 (WATER LEVEL)

18" R.C.P.

WATER LEVEL - EL. 38.0'±

6" THK. RIP RAP AT OUTFALL 6' WIDE x 10' LONG

NOTE: POND IS CHARGED BY UNDERGROUND STREAMS & RUNOFF

BOT. ELEV. 23'±

SECTION AT POND INLET

NOTE: POND OUTFALL PIPE TO BE SET IN FIELD AT NORMAL POND WATER ELEVATION OR TO 0.6' LOWER

TOP OF WALL EL. 41.8

#6@12"c/c E.W.

8" REINF. CONC. WALL TO BE RETURNED

2" DIA. OUTFALL ORIFICE OUTLET INV. 38.1'±

WATER LEVEL - EL. 38.6'

12" THK. RIP RAP

4'-6"

#6 DOWELS @ 24" c/c

#6@12" c/c

SECTION AT COOLING POND OUTLET

SURVEY INFORMATION TAKEN FROM DWG. DATED 11/19/76 BY ATKINSON & WALTON, CIVIL ENG'RS.

NOTE: REINF. CONC. PIPE WITH LESS THAN 2' OF COVER, IS TO BE CLASS IV, WALL "B".

LEGEND

30 EXIST'G. CONTOURS

30 NEW CONTOURS

PLANNING BRD. CHAIRMAN — DATE

PLANNING BRD SECRETARY — DATE

APPROVED BY PLANNING BRD. — DATE

BLOCK 36, LOT 13B
RKL CONTROLS INC.
AREA = 30.2345 ACRES = 1,317,014.82 SQ. FT.
BUILDING AREA = 40,000 SQ. FT.
LOT COVERAGE = 3.03 %
ZONING CLASS I-1 GENERAL INDUST.

NOTE:
ALL OPEN AREAS TO BE SEEDED.
BANKS AT POND TO BE TOP SOILED & SEEDED.
BANKS AT "ARRAYS" TO BE SODDED.

THIS PLAN IS HEREBY APPROVED BY THE BURLINGTON CO. PLANNING BOARD SUBJECT TO THE RESTRICTIONS, AGREEMENTS & CONDITIONS SET FORTH BY THE BURLINGTON CO. PLANNING BRD.

BY — DATE

REV. 11-11-77 PARKING LOT & ENG. WALK REVD.
REV. 7-27-77 REVISED DRAINAGE INLET AT POND
REVISED ROYAL 5-15-77
REVISED 9-1-76
REVISED 8-31-76
REVISED 8-24-76

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON, N.J.

PAULL ENGINEERING
498 N. KINGS HIGHWAY
CHERRY HILL, N.J. 08034

DATE		DWG. No.
7/16/76	TOPO & DRAINAGE PLAN	1-A
SCALE 1" = 50'		75-230
DR. R.S.		

200'-0"

8 BAYS @ 20'-0" = 160'-0"

19'-4" | 19'-4" | 8" | 8"

200'-0" — 8 BAYS @ 20'-0"

160'-0"

COOL STORAGE 20'-33"

AIR LOCK #4

AIR LOCK #5

AIR LOCK #3

AIR LOCK #2

8" BLOCK TO UNDERSIDE OF RF. DECK

8" BLOCK TO UNDERSIDE OF ROOF DECK

8" BLOCK = 12" HIGH W/ WOOD JOIST & PLYWOOD COVER.

INSULATED SMOKE VENT ABOVE

METAL STAIRS W/HR.

DOCK LEV.

CONC. STEP

6" CONC. FLOOR SLAB OVER 12" SAND BASE W/ PLASTIC VAPOR BARRIER.

FIN. FLOOR - ELEV. 50'-0

#1 OFFICE 12'-12'

#2 OFFICE 12'-12'

#3 OFFICE 12'-12'

#4 OFFICE 12'-12'

#5 OFFICE 12'-16'

#6 OFFICE 12'-16'

#7 OFFICE 12'-12'

#8 OFFICE 12'-16'

BEARING PARTITION

LUNCH ROOM 16'-33'

DRAFTING ROOM

INTERVIEW ROOM 6'-6"

AIR LOCK 6'-12'

GENERAL OFFICE AREA

PRESIDENTS OFFICE 18'-24'

WOMENS LAV.

MENS LAV.

SHOP LOCKER & WASH RM. 18'-32'

MECHANICAL ROOM & PUMP ROOM 26'-26'

DISPLAY ROOM 22'-27' (NO WOOD FRAMING)

COMPUTER AREA

WATER STORAGE TANKS

ENTR. CANOPY SEE DWG. #7

4' WIDE CONC. WALK

INSULATED GLASS IN FIXED SASH - NO UNITS THIS WALL ONLY - 5'-9½"

FOR ENLARGED PLAN OF THIS AREA - SEE DWG. #6

FOR FLOOR SLAB REINF. AT PARTITIONS - SEE DWG. #4

2" SPRAYED URETHANE FOAM INSULATION WITH 30 MIL WHITE SILICONE PROTECTIVE COATING

2"x8" WOOD BLOCK

1½" STEEL ROOF DECK.

24" STL. JOIST

CLEAR HEIGTH 18'-0" MIN. POINT @ 16'-0" LOW POINT.

20'-0"

BLOCK TO BE SEMI-SOLID "WAYLITE" WITH FLUSH JOINT OUTSIDE - STRIKE INSIDE

12" BLOCK WALL W/ DUROWAL REINF. @ 24" O.C.

1" SPRAYED URETHANE FOAM WITH 30 MIL WHITE SILICONE PROTECTIVE COATING

ALL EXTERIOR BLOCK SURFACES TO BE SPRAYED WITH SILICONE MOISTURE BARRIER, & ADHESIVE PRIOR TO APPLYING URETHANE INSULATION.

EXP. JT. MAT'L.

6" CONC. FLOOR SLAB

FIN. FLOOR ELEV. 50'-0"

SOLID BLOCK BELOW GRADE

4" SAND & GRAVEL BASE

VAPOR BARRIER

PERIMETER INSULATION

5'-0" MIN.

TYPICAL WALL SECTION

SCALE 3/4"=1'-0"

NOTE:
FOR DOOR SCHEDULE & ROOM FINISH SCHEDULE, SEE DWG. NO. 3

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON TWP. , N.J.

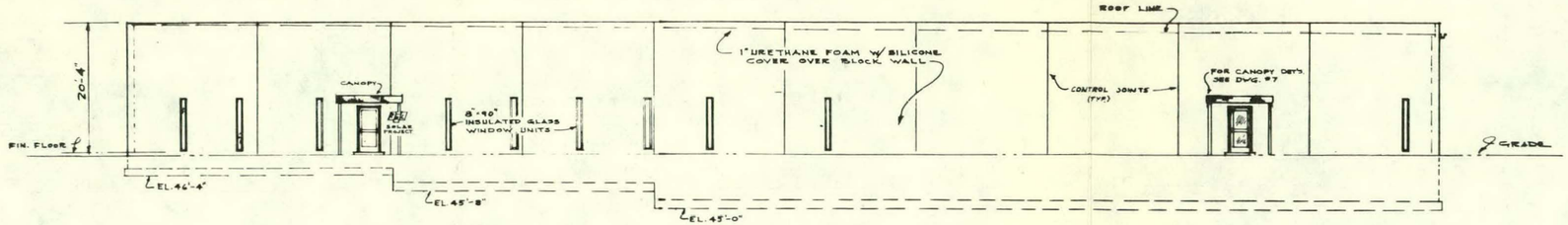
PAULL ENGINEERING
498 N. KINGS HIGHWAY
CHERRY HILL, N.J. 08034

DATE 7-12-76
SCALE 1/8"=1'-0"
DWN. RAP

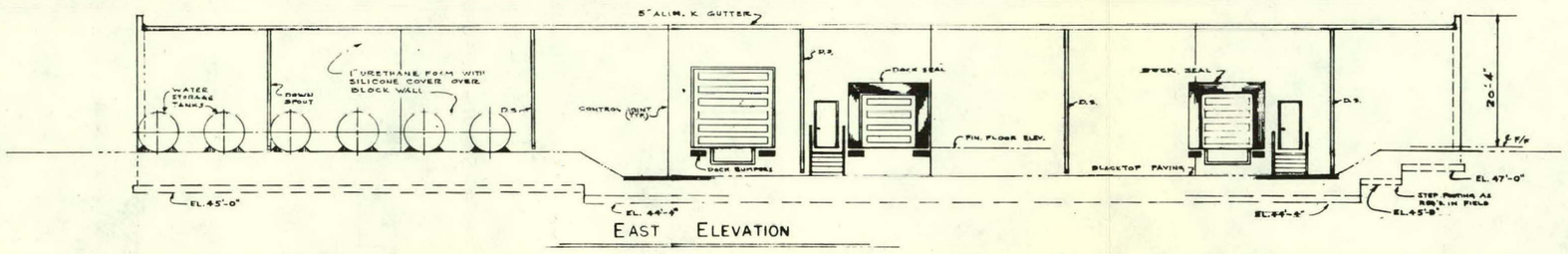
FLOOR PLAN

DWG. NO. 2
75-230

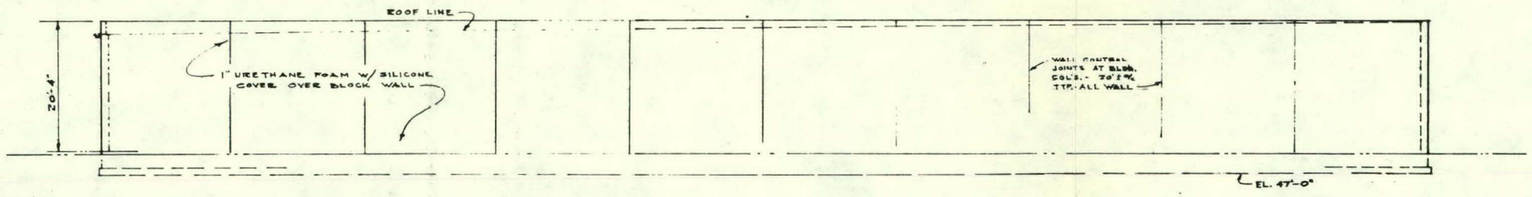
REV. 9/14/77
REV. 3/7/76
REV. 8/24/76



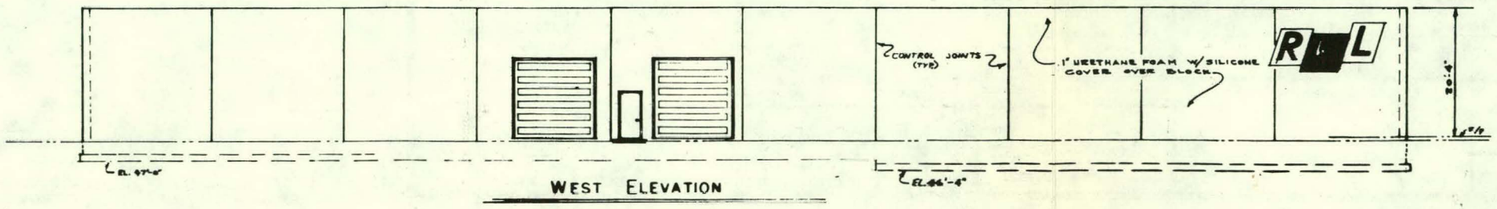
SOUTH ELEVATION - FRONT



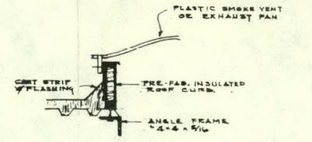
EAST ELEVATION



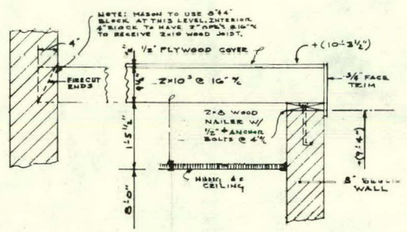
NORTH ELEVATION



WEST ELEVATION



TYP. ROOF OP'G. DETAIL



SECTION 3/3
THRU OFFICE PARTITION

DOOR SCHEDULE

MARK	SIZE	MATL.	FRAME	LINTEL
A	12'-12'	OVERHEAD SECTIONAL	STL. CHANNEL	W 8x15 @ EL.
B	8'-8'	OVERHEAD SECTIONAL	STL. CHANNEL	W 8x15 @ EL.
C	3'-7"	ALUM. & INSUL. GLS.	ALUM.	RC. CONC.
D	3'-7"	HOL. MET.	H.M.	do.
E	10'x10'	OVERHEAD SECTIONAL	WOOD	W8x15 @ E
F	28'-6"	WOOD	WOOD	—
G	28'-6"	H.M.	H.M.	RC. CONC.
H	3'-7"	H.M. & INSUL. GLASS	H.M.	do

NOTE: ALL O.H. DOORS TO BE ELECT. OPERATED.

ROOM FINISH SCHEDULE

ROOM	FLOOR	CEILING	WALLS	REMARKS
DRAFTING	CARPET	HUNG AC.	DRYWALL W/PAINT	4 PAINTED BLK.
INTERVIEW	do.	do.	do.	do.
TOILET RM.	do.	do.	do.	do.
OFFICES & FITTING R.	do.	do.	do.	do.
GEN. OFF.	do.	do.	do.	do.
PRES. OFF.	do.	do.	WD. PANEL	—
EXT. LAV.	do.	do.	DRYWALL W/PAINT	4'-0" TILE WAINSCOT
M & W LAV.	do.	do.	do.	do.
LOCKER RM.	CONC.	do.	do.	do.
LUNCH RM.	CARPET	do.	do.	4 PAINTED BLK.
DISPLAY RM.	do.	do.	do.	CEILING @ 10'-0" HEIGHT
MECH. RM.	CONC.	—	PAINTED BLOCK	
COOL RM.	do.	—	do.	
AIRLOCK & ENT.	do.	—	do.	
REC.	do.	—	do.	

NOTE: UNLESS HEIGHT = 8'-0" UNLESS NOTED

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON TWP. N. J.

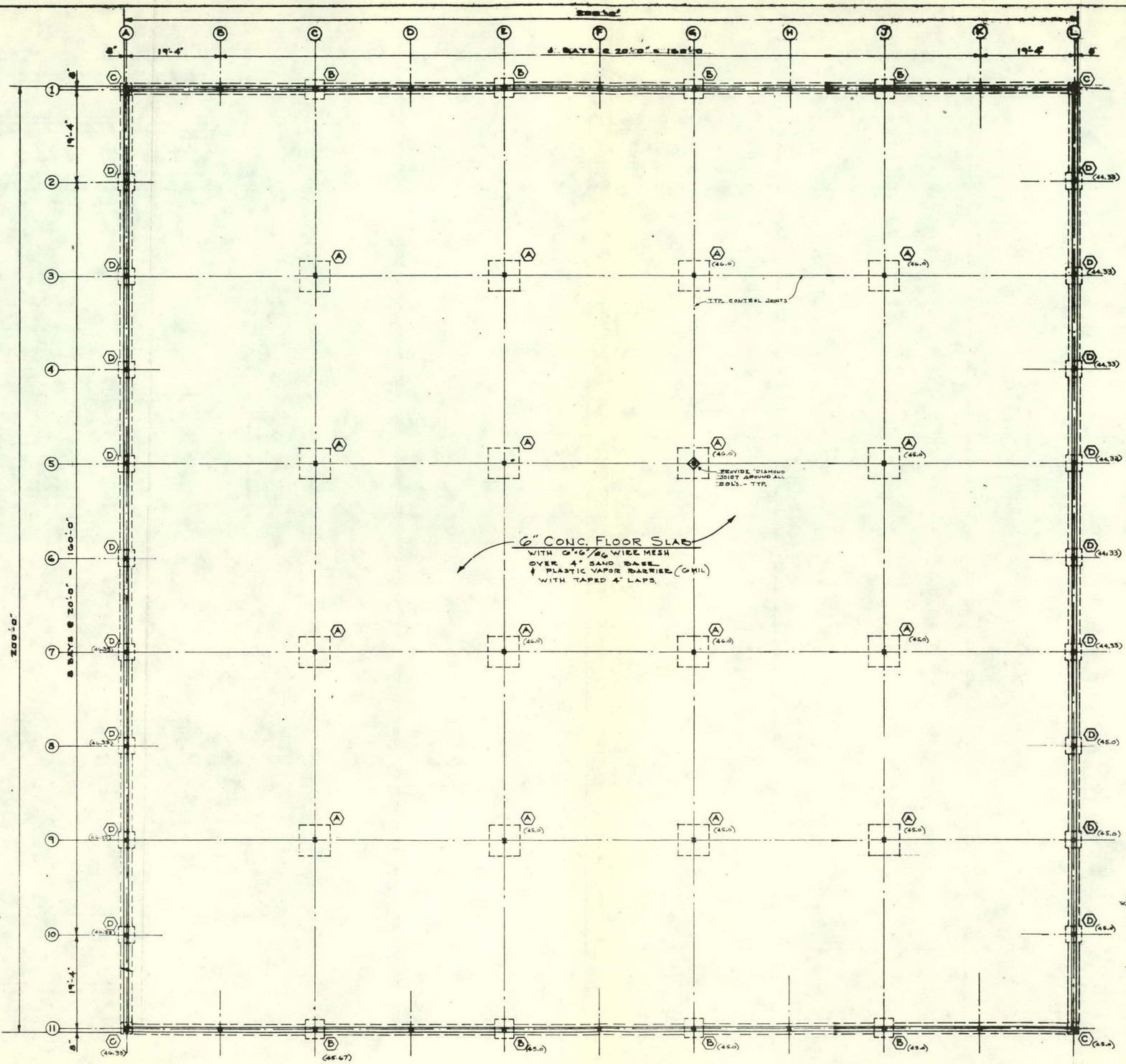
PAULL ENGINEERING
498 N. KINGS HIGHWAY
CHERRY HILL, N. J. 08034

DATE 7-14-76
SCALE 1/8"=1'-0"
DRAWN B.J.P.

ELEVATIONS

DWG. NO. 3
78-230

REV. 2 10/77
REV. 9/1/76



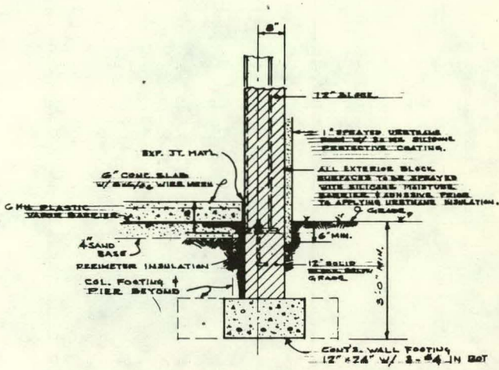
FOOTING SCHEDULE

ALLOWABLE BEARING = 2000 PSF

- (A) 6'-0" SQ. x 15" THK. .. REINF. = 7-#6 E.W.
- (B) 4'-0" SQ. x 12" THK. REINF. = 5-#5 E.W.
- (C) 2'-6" SQ. x 12" THK. REINF. = 4-#4 E.W.
- (D) 3'-6" SQ. x 12" THK. REINF. = 4-#4 E.W.

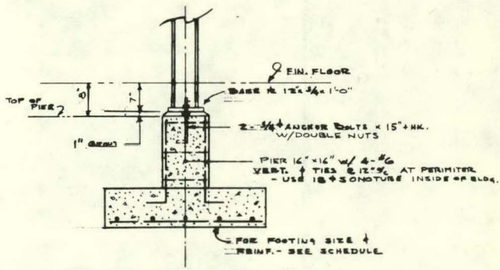
BOTTOM OF FOOTINGS = EL. 47.0' UNLESS NOTED AS (BF.)

ALL CONC. TO BE 3000 P.S.I. -28 DAYS.
CONC. FLOOR SLAB TO BE COATED WITH LIQUID HARDENER.
ALL FOOTINGS TO REST ON UNDISTURBED SOIL.
ALL CONC. WORK TO BE IN ACCORDANCE WITH CURRENT A.C.I. CODE.



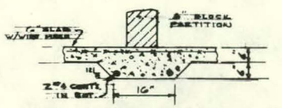
TYPICAL SECTION

SCALE 3/4"=1'-0



TYPICAL FOOTING DETAIL

SCALE 3/4"=1'-0



TYP. SLAB DETAIL AT BLOCK PARTITIONS

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON TWP. N.J.

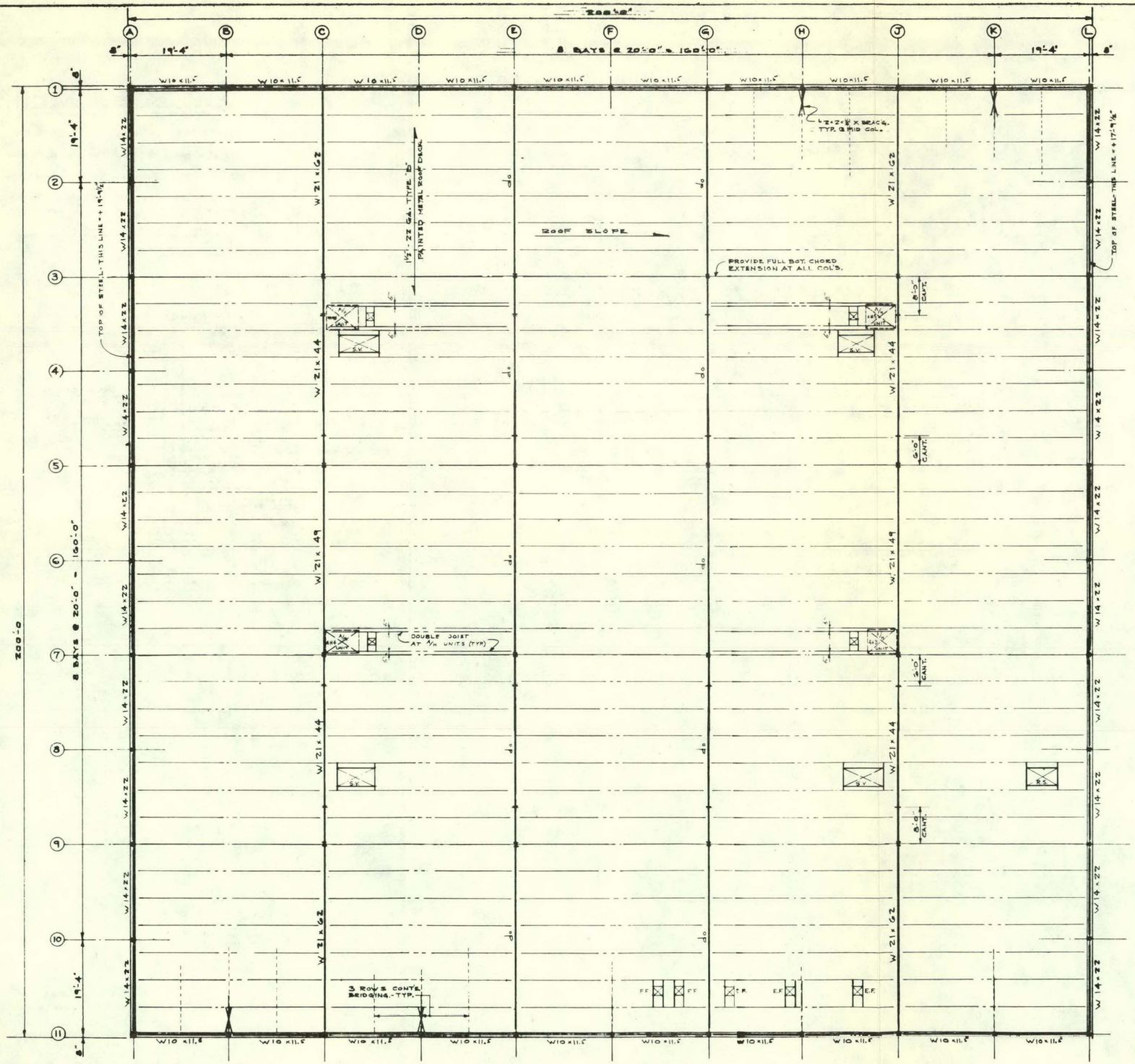
PAULL ENGINEERING
498 N. KINGS HIGHWAY
CHERRY HILL, N. J. 08034

DATE 7-14-76
SCALE 1/8"=1'-0"
DWN. EJP

FOUNDATION PLAN

DRWG. NO. 4
75-280

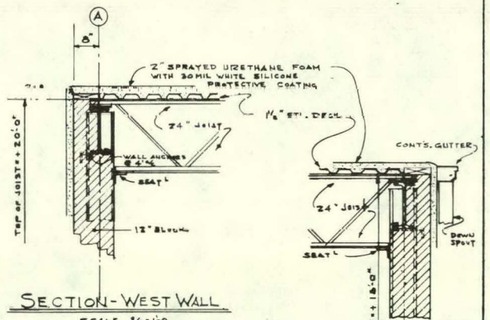
REV. 3/14/77
REV. 4/21/76



STRUCTURAL STEEL NOTES:

1. All structural steel to be A.S.T.M. A-36 designed, fabricated and erected in accordance with current A.I.S.C. Code.
2. Shop connection to be welded or bolted with high strength bolts. Field bolts to be 3/4 Ø high strength bolts tightened by "Turn of Nut" method.
3. All steel to have one shop coat of primer.
4. All steel to be erected true & plumb & temporarily guyed until bld'g. frame is self-supporting. As erection work progresses, the framing is to be securely bolted to provide for dead load, wind and erection stresses.
5. Steel joist are to be "H" series, prime painted, and designed and fabricated in accordance with A.I.S.C. and S.J.I Codes.
6. Roof Deck to be 1½" - 22 Ga. type "B" painted, continuous over a min. of 3 spans. Decking and accessories to be installed in accordance with manufacturers recommendations. INSTALL USING WELDING WASHERS.
7. Roof Design Loads:

Live Load	- 30 P.S.F.
Dead Load	- 20 P.S.F.
TOTAL	- 50 P.S.F.

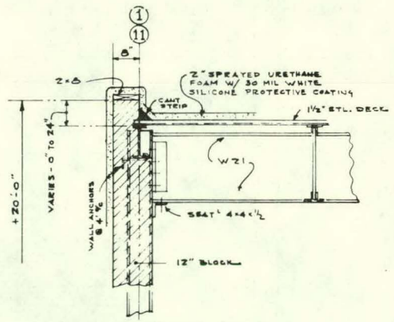


SECTION - WEST WALL

SCALE 3/4"=1'-0

SECTION - EAST WALL

SCALE 3/4"=1'-0



SECTION - NORTH & SOUTH WALLS

SCALE 3/4"=1'-0

ALL STEEL JOIST = Z4H8
ALL INTERIOR COL'S. = W8 x 31
ALL EXTERIOR COL'S. = W8 x 24
5/H = AIR HANDLER
S.V. = SMOKE VENT
E.F. = EXHAUST FAN
R.S. = ROOF SCUTTLE
ALL ROOF OPENING FRAMES ARE L 3 x 3 x 4 x 5/16

REV. 3/15/77 REV. 9/9/76

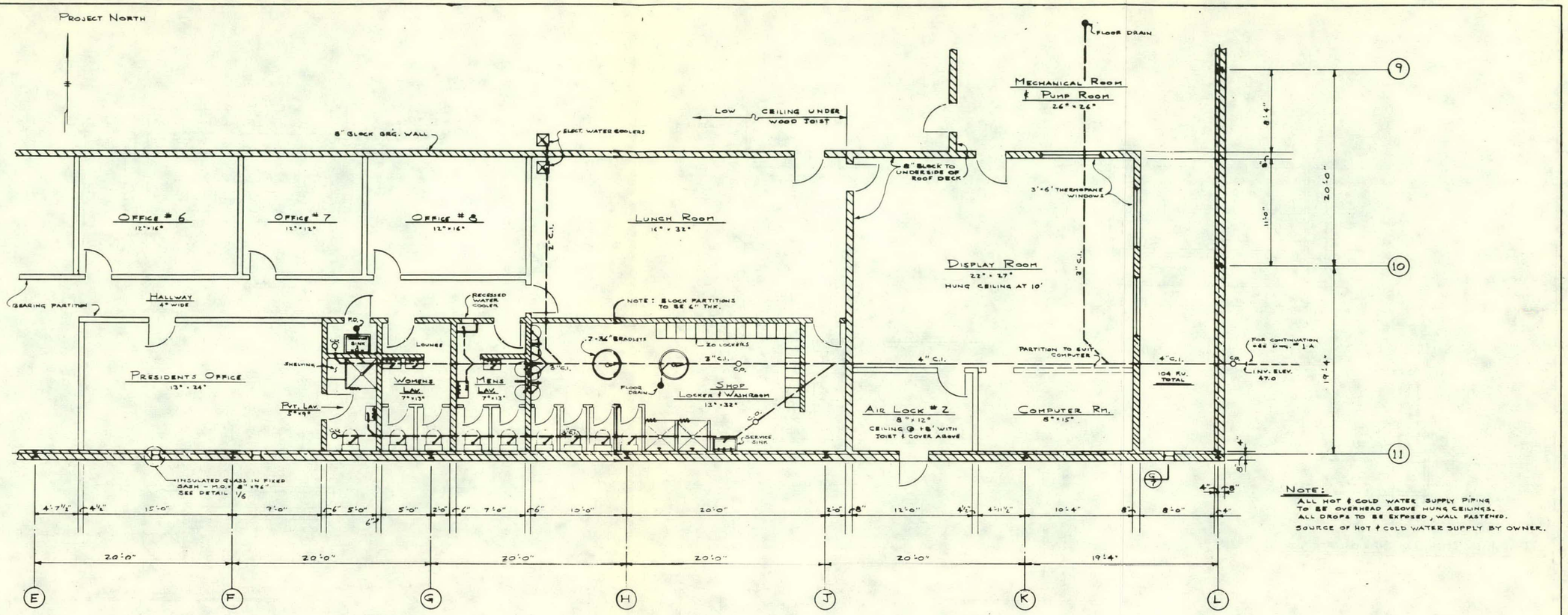
PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON TWP. N.J.

PAULL ENGINEERING
406 N. KINGS HIGHWAY
CHERRY HILL, N. J. 08034

DATE 7-14-76
SCALE 1/8"=1'-0"
DR. J.P.
CK'D.

ROOF FRAMING PLAN

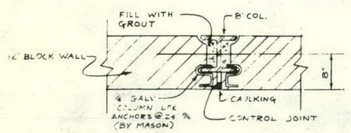
DWG. NO. 5
75-230



NOTE:
ALL HOT & COLD WATER SUPPLY PIPING TO BE OVERHEAD ABOVE HUNG CEILINGS. ALL DROPS TO BE EXPOSED, WALL FASTENED. SOURCE OF HOT & COLD WATER SUPPLY BY OWNER.

PARTIAL OFFICE AREA LAYOUT

SCALE 1/4" = 1'-0"



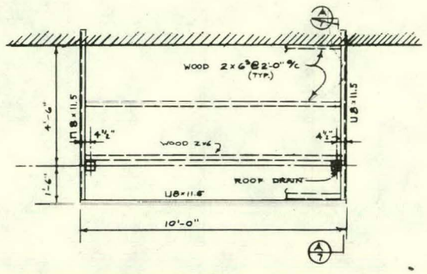
TYPICAL CONTROL JOINT DETAIL

SCALE 1" = 1'-0"

PROPOSED BUILDING FOR
RKL CONTROLS
LUMBERTON TWP. N.J.

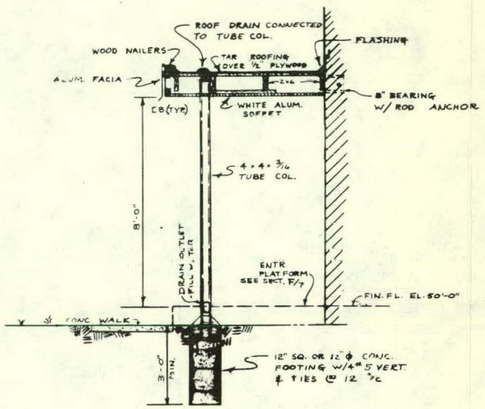
PAULL ENGINEERING
400 N. KINGS HIGHWAY
CHERRY HILL, N. J. 08034

DATE 3-24-77 SCALE 1/4"=1'-0" DWN. JK	OFFICE AREA LAYOUT	DWG NO. 6 75-220



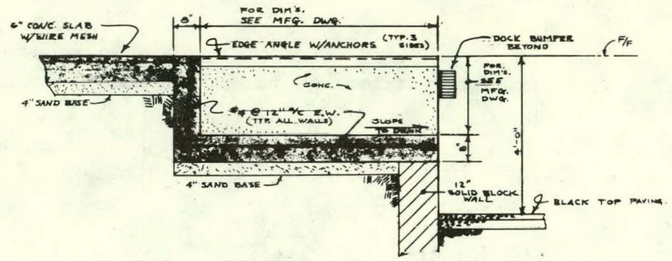
ENTRANCE CANOPY — PLAN

SCALE ½"=1'-0"



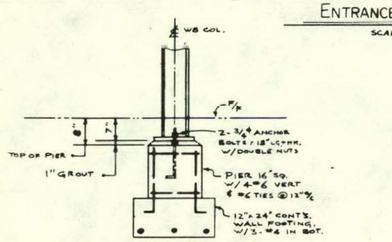
ENTRANCE CANOPY — SECTION (A/7)

SCALE ½"=1'-0"



SECT. (B/7) THRU DOCK LEVELER

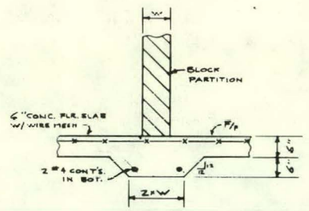
SCALE = ¾"=1'-0"



TYP. PIER DETAIL AT INTERMDIATE COL'S.

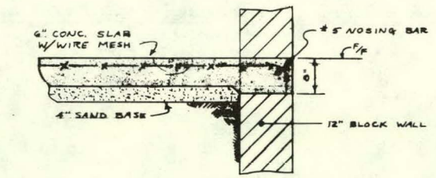
LINE 1" & "11"

SCALE ¾"=1'-0"



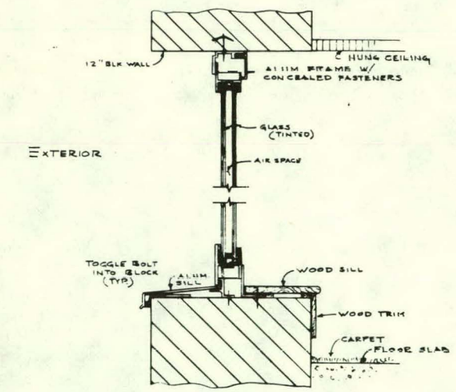
TYP. SLAB DET. AT BLK. PARTITION

SCALE ¾"=1'-0"



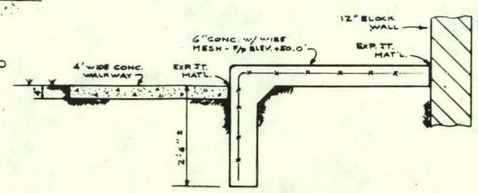
TYP. O.H. DOOR SILL SECTION (G/7)

SCALE 1"=1'-0"



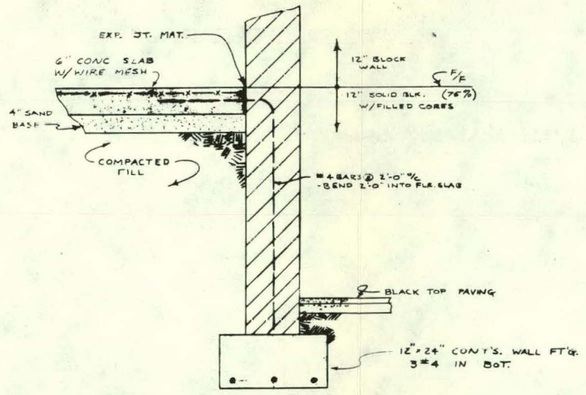
SECTION (G/7) TYPICAL INSULATED GLASS WINDOW DETAIL

SCALE 3"=1'-0"



SECTION (F/7) THRU ENTR. STEP.

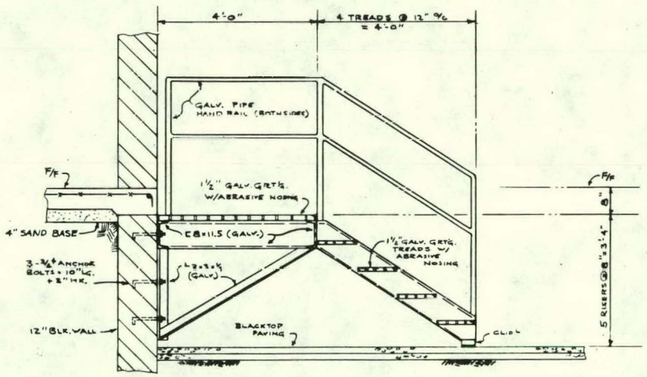
SCALE ¾"=1'-0"



WALL SECTION (D/7) TYPICAL AT TRUCK DOCK

COL. LINE "L" BETWEEN LINE "2" & "9"

SCALE 1"=1'-0"



SECTION (E/7) THRU. METAL STAIRS (TYPICAL)

SCALE ¾"=1'-0"

PROPOSED BUILDING FOR

RKL CONTROLS

LUMBERTON TWP. N.J.

PAULL ENGINEERING

498 N. KINGS HIGHWAY

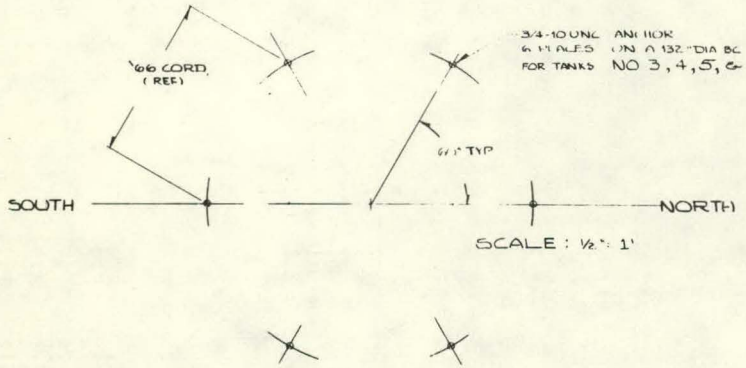
CHERRY HILL, N. J. 08034

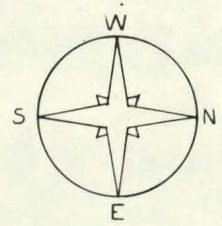
DATE 3-24-77 SCALE: AS NOTED DRN. RMS

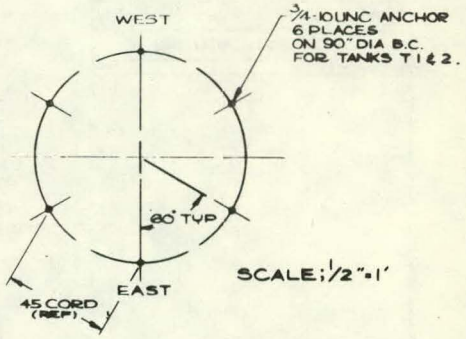
SECTIONS

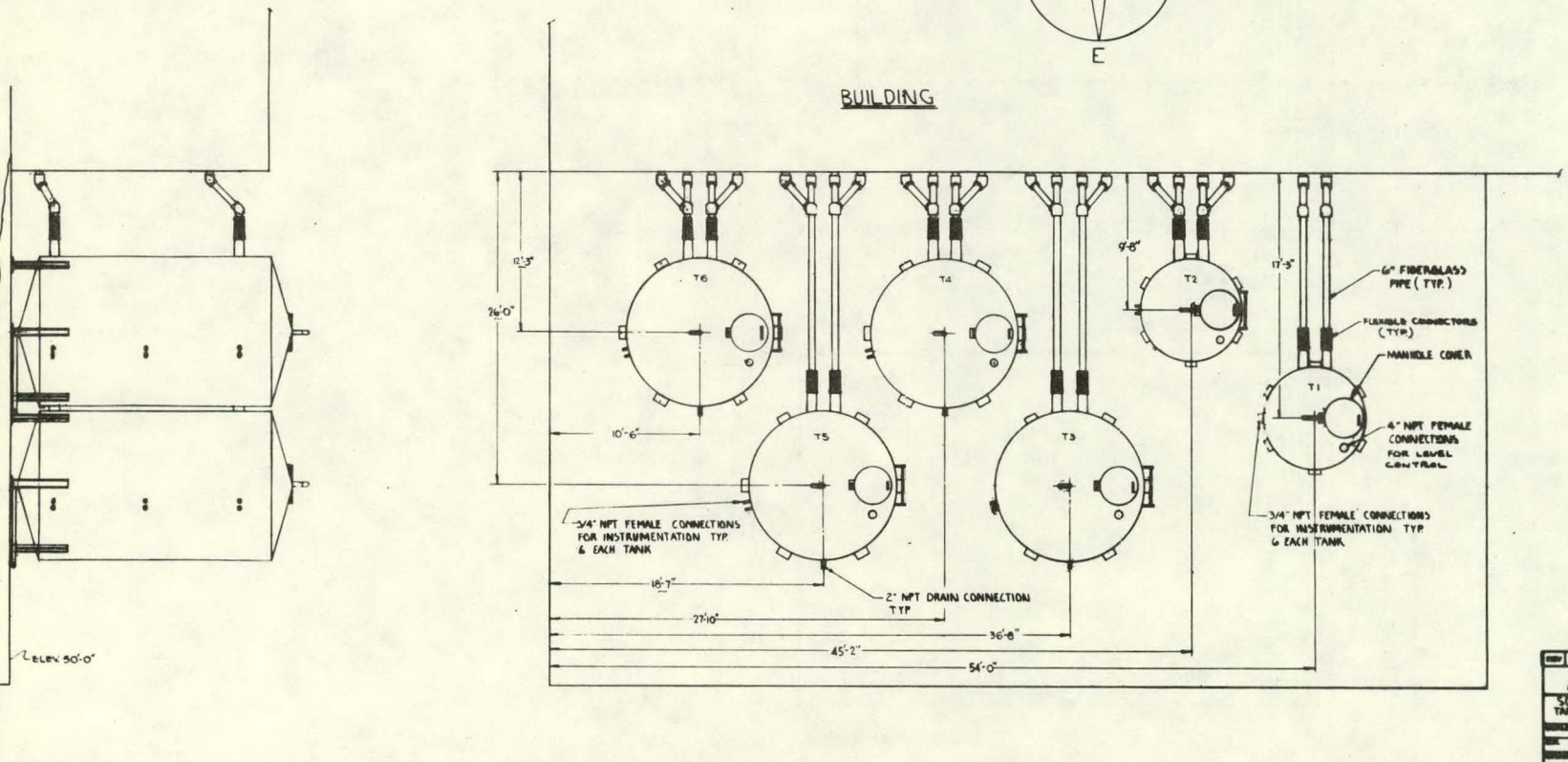
DWG NO 7

77.230







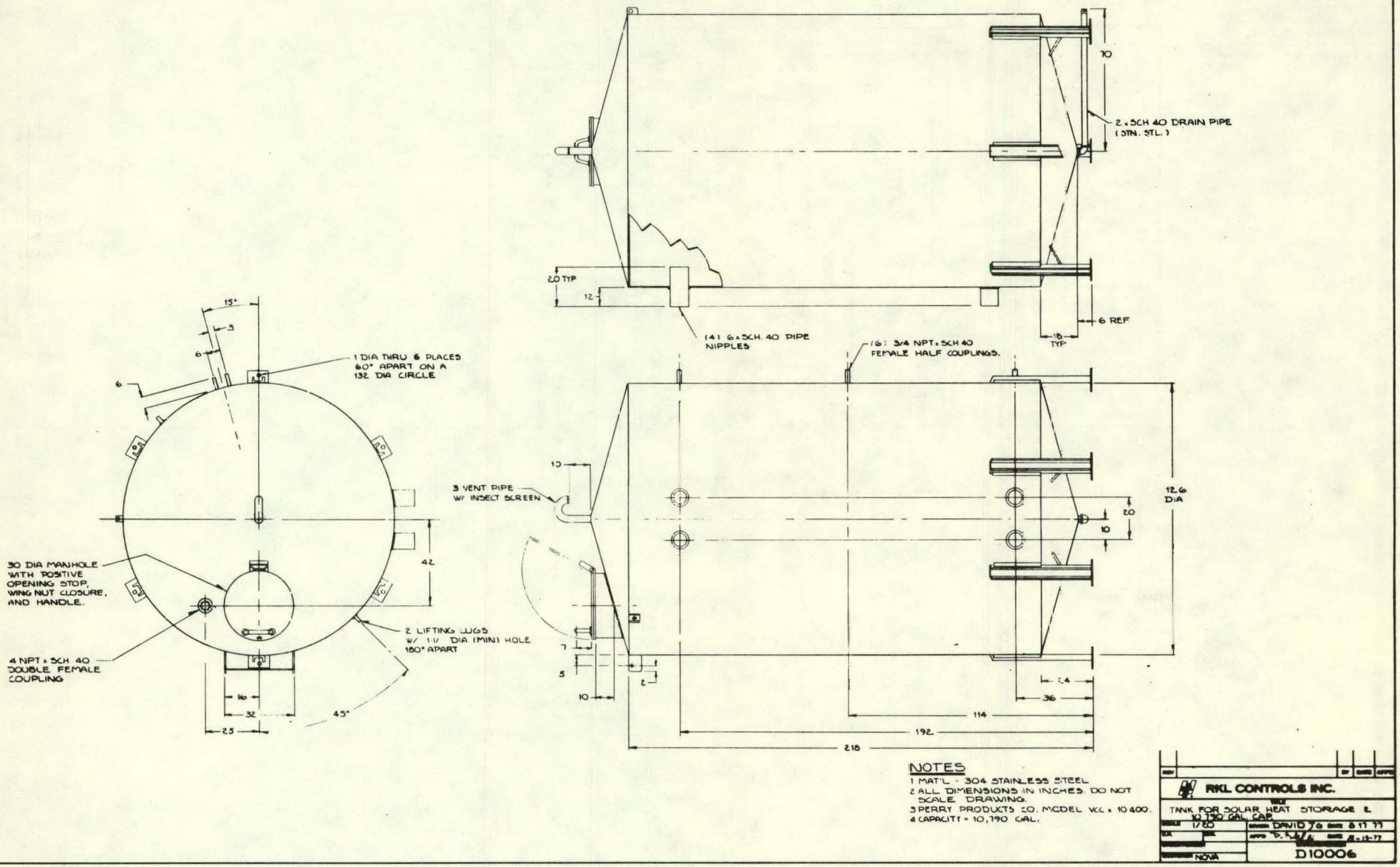


RKL CONTROLS INC.

SOLAR HEATING TANK ASSEMBLIES — PLANE SIDE VIEWS

3/8" = 1'-0"

DN 10010



NOTES

1 MAT'L - 304 STAINLESS STEEL
2 ALL DIMENSIONS IN INCHES. DO NOT SCALE DRAWING.
3 PERRY PRODUCTS CO. MODEL VCC x 10 400.
4 CAPACITY = 10,790 GAL.

RKL CONTROLS INC.

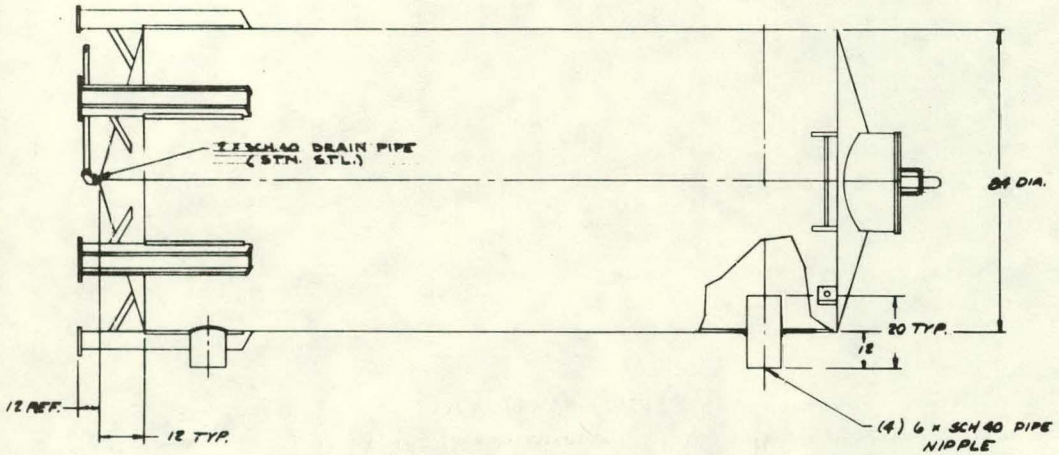
TANK FOR SOLAR HEAT STORAGE 8. 10,790 GAL. CAP.

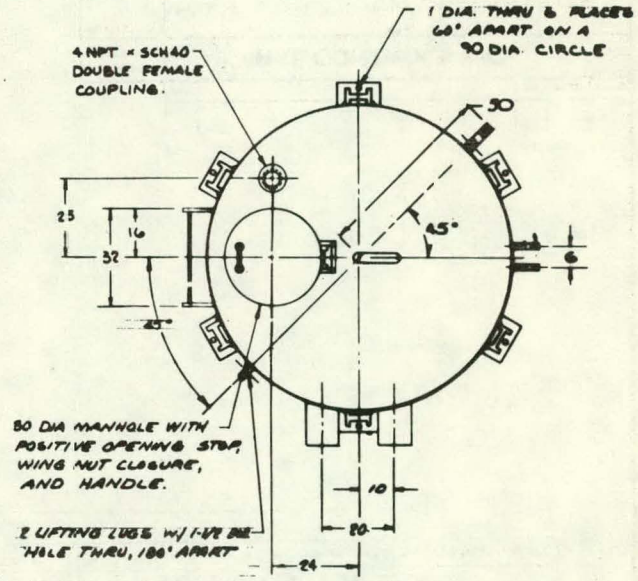
SCALE 1/60 DRAWN DAVID Z.G DATE 8 17 77

APPD D.K.Z. DATE 8-18-77

CUSTOMER NOVA

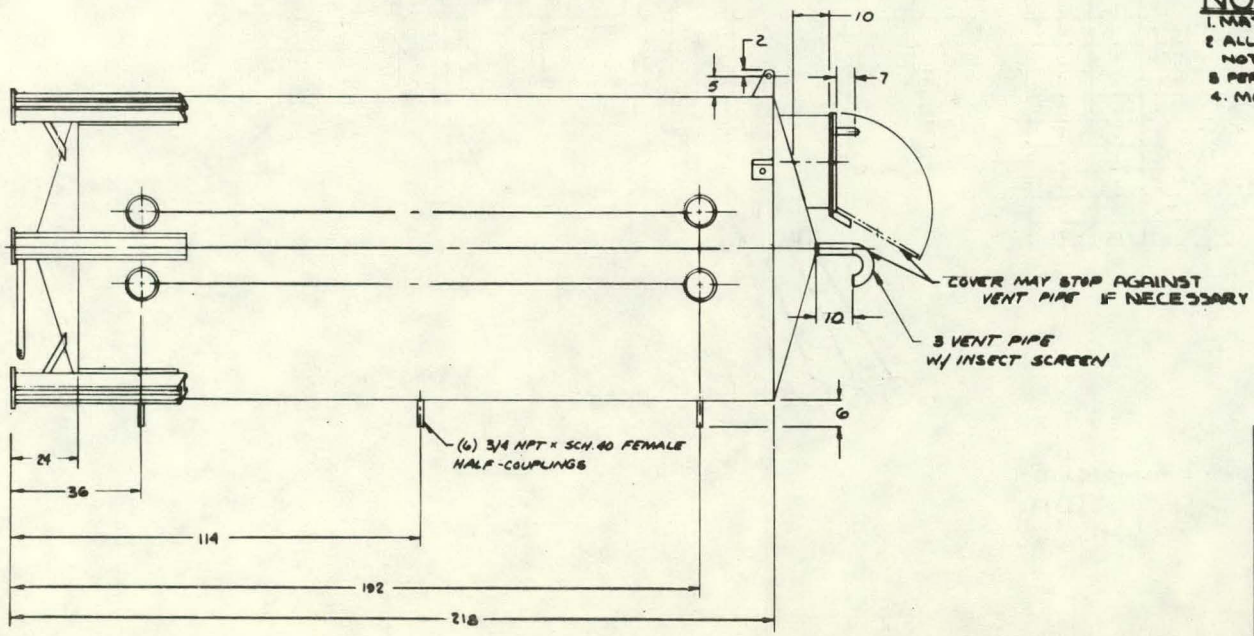
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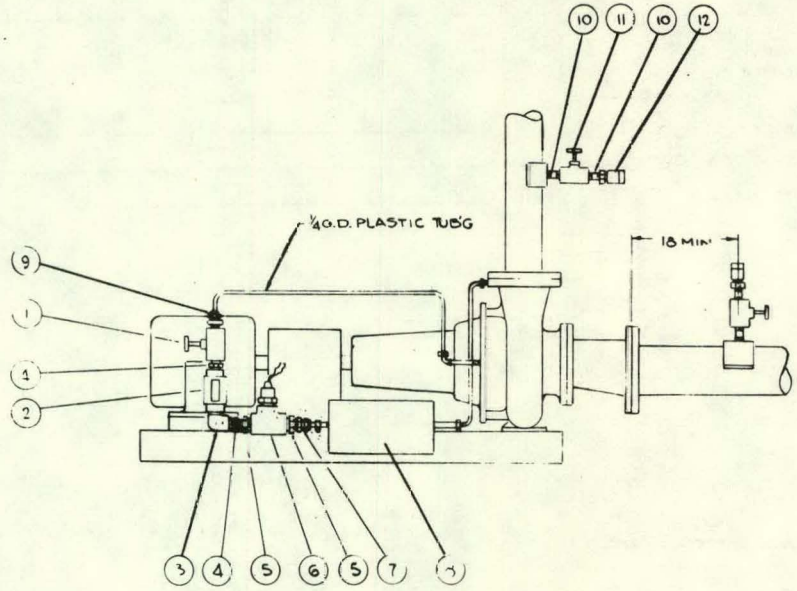
NOTES

1. MAT'L - 304 STAINLESS STEEL
2. ALL DIMENSIONS IN INCHES. DO NOT SCALE DRAWING.
3. PERRY PRODUCTS CO. MODEL VCC
4. MAX. CAPACITY - 4,800 GAL.



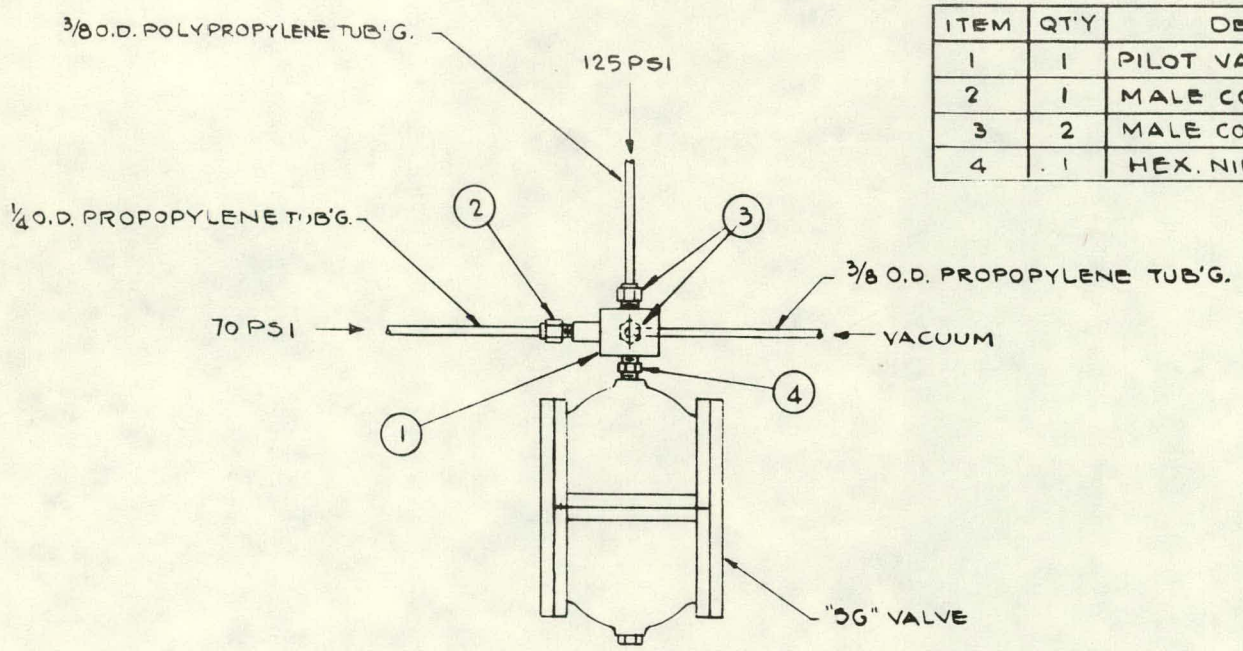
RKL CONTROLS INC.	
TITLE: TANK FOR SOLAR HEAT STORAGE I 4,800 GAL. CAP.	
SCALE: N.S.	DRAWN: E.S. DATE: 8-15-77
	APPD: DATE: 8-18-77
	C-10005
NOVA -	

NOTE.
QTYS. SHOWN ARE FOR ONE PUMP



ITEM	QTY	DESCRIPTION
1	1	BAR STOCK SHUT-OFF VALVE - ½ NPT
2	1	ERNST RATE-FLO #RA 404, ½ NPT, 1-4 GPM
3	1	½ STREET EL
4	2	½ NIPPLE
5	2	RED BUSHING 1 MPT - ½ NPT
6	1	ERNST MAGNETIC PADDLE FLOW SW. IND. 3-5 GPM
7	1	SWAGELOC MALE CONN. #600-1-8
8	1	FIN TYPE COOLER
9	1	SWAGELOC MALE CONN #400-1-8
10	2	¼ NIPPLE
11	2	¼ BAR STOCK SHUT-OFF VALVE
12	2	SCOVILL QUICK DISCONNECT #4104-12 & MATING PT.

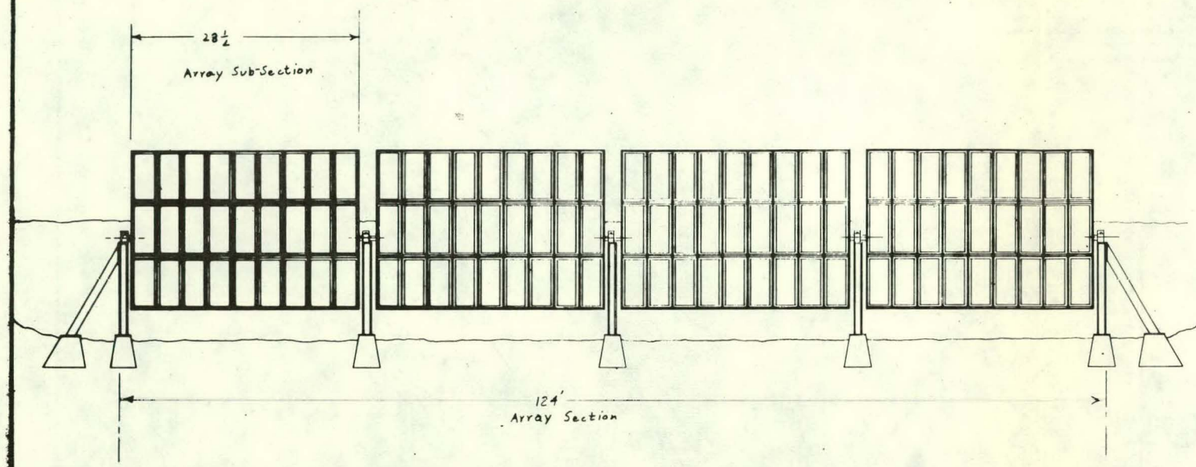
REV		BY	DATE	APPD
TOLERANCES (EXCEPT AS NOTED)	RKL CONTROLS INC.			
DECIMAL ±	TITLE: MECH. ROOM, TYP. PUMP INSTM'TN. ARRG'T.			
FRACTIONAL ±	SCALE: —	DRAWN E. WILFLING	DATE	
ANGULAR ±	E.R.	APPD	DATE	
	CUSTOMER: NOVA	DWG NO: DN-100097		

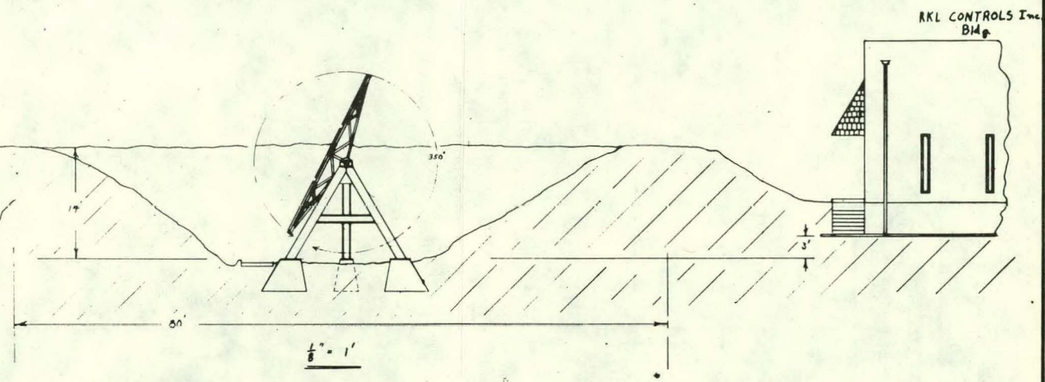


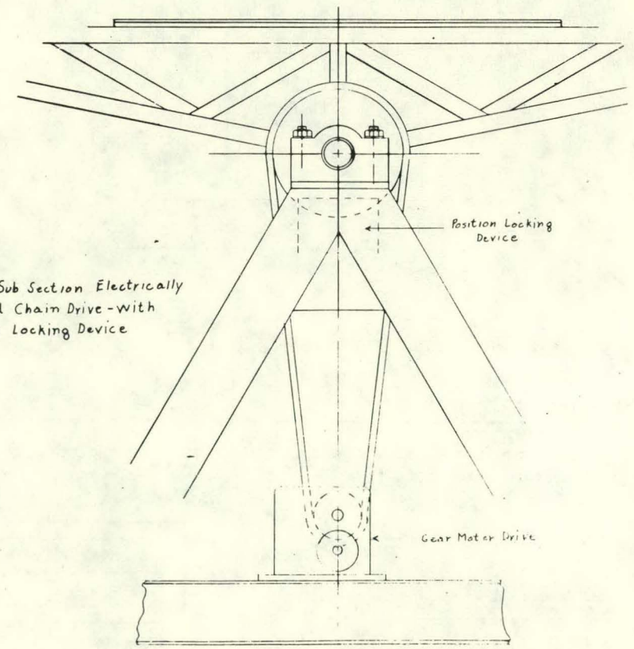
ITEM	QT'Y	DESCRIPTION	MANUF.
1	1	PILOT VALVE #250A-3-10-20	HUMPHREY PROD.
2	1	MALE CONNECTOR #3115-60-11	LEGRIS
3	2	MALE CONNECTOR # 3115-60-14	LEGRIS
4	1	HEX. NIPPLE 1/4 MPT #4HN	CAJON

REV		BY	DATE	APP'D

TOLERANCES (EXCEPT AS NOTED)	RKL CONTROLS INC.	
DECIMAL ±	TITLE: MECH ROOM TYP. SG VALVE ARR'G'T.	
FRACTIONAL ±	SCALE: E.R. / B/M.	DRAWN E. WILPLING DATE
ANGULAR ±	ORDER NUMBER	APP'D DATE
	CUSTOMER NOVA	DRAWING NUMBER BN 10026

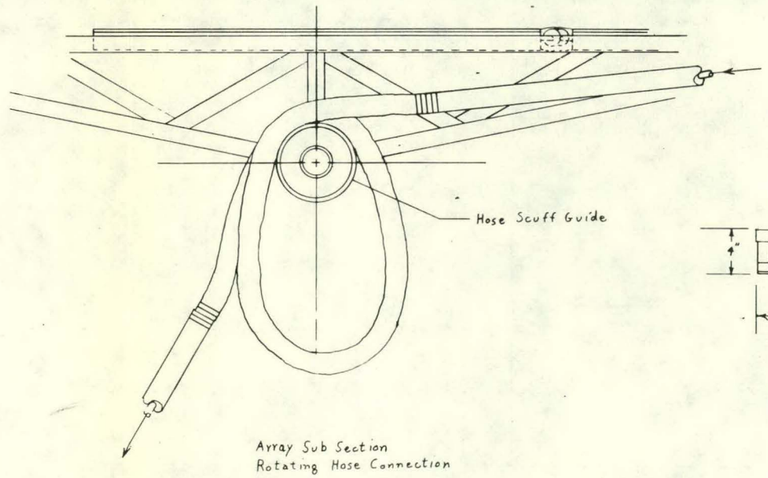




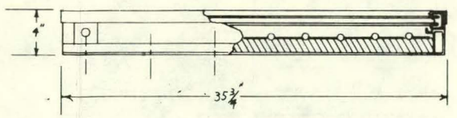


Array Sub Section Electrically operated Chain Drive - with position Locking Device

1" = 1'



Array Sub Section
Rotating Hose Connection
Return Line



5/16"ø Dowels To be 36½" x 84½" x 4" (3'-0⅛") x (7'-0¼") x 0" by R.K.L.

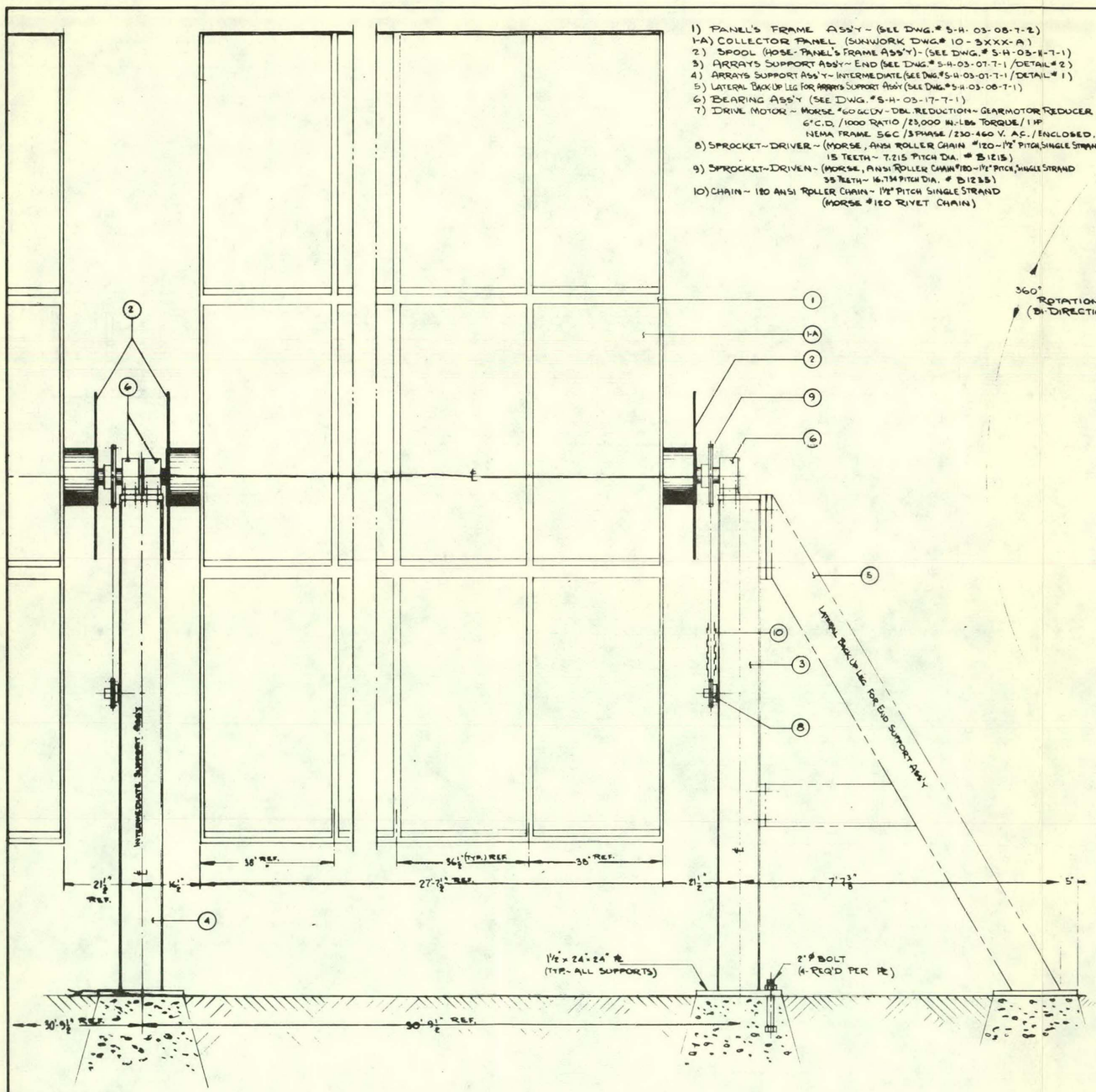
Dual Glazed - Sunworks Inc. - Flat Plate Liquid Surface Mounted Module

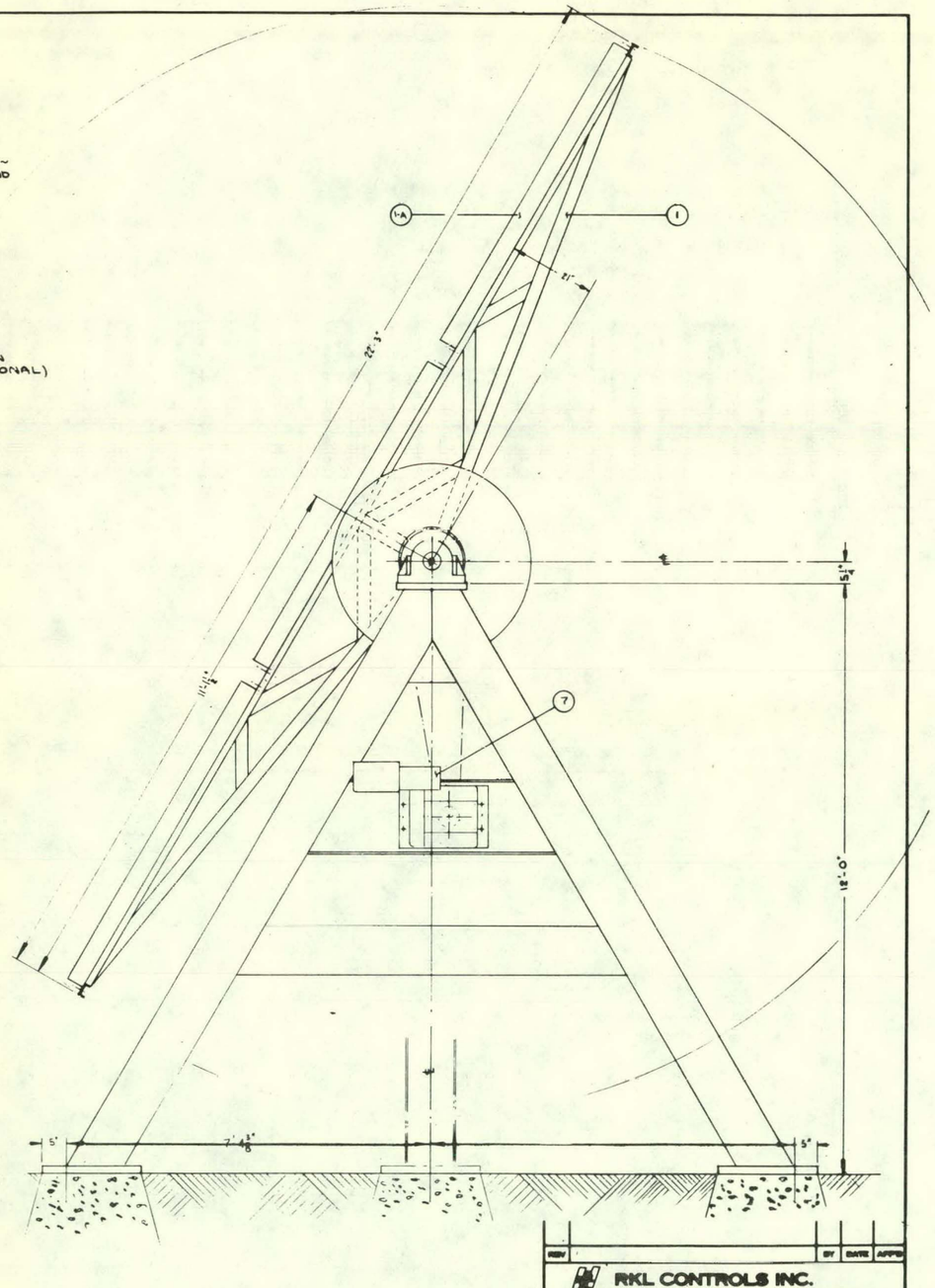
2" = 1'

THIS DRAWING IS AN ORIGINAL DESIGN AND ENGINEERED CONCEPT AND IS LOANED CONFIDENTIALLY FOR USE IN CONNECTION WITH THE SALE TO PURCHASE OF ACCESSORIES MANUFACTURED BY RKL CONTROLS AND EQUIPMENT AS A THE INFORMATION AND/OR KNOW-HOW HEREIN CONTAINED MAY NOT BE USED, THE DRAWINGS MAY NOT BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF THE OWNER. ALL COPIES OF THIS DRAWING TO BE RETURNED IMMEDIATELY UPON REQUEST.

TOLERANCES (UNLESS OTHERWISE NOTED)	RKL CONTROLS Inc. Haines port, Md.
DECIMAL ±	Information Print
SCALE as Noted	DRAWN BY GG.
FRACTIONAL ±	APPROVED BY RKL
ANGULAR ±	TITLE Array Section + Sub Section - Drive and Hose connection enlarged - Collector Areas enlarged
DATE	RKL Bldg. L-A-HW-AC-140

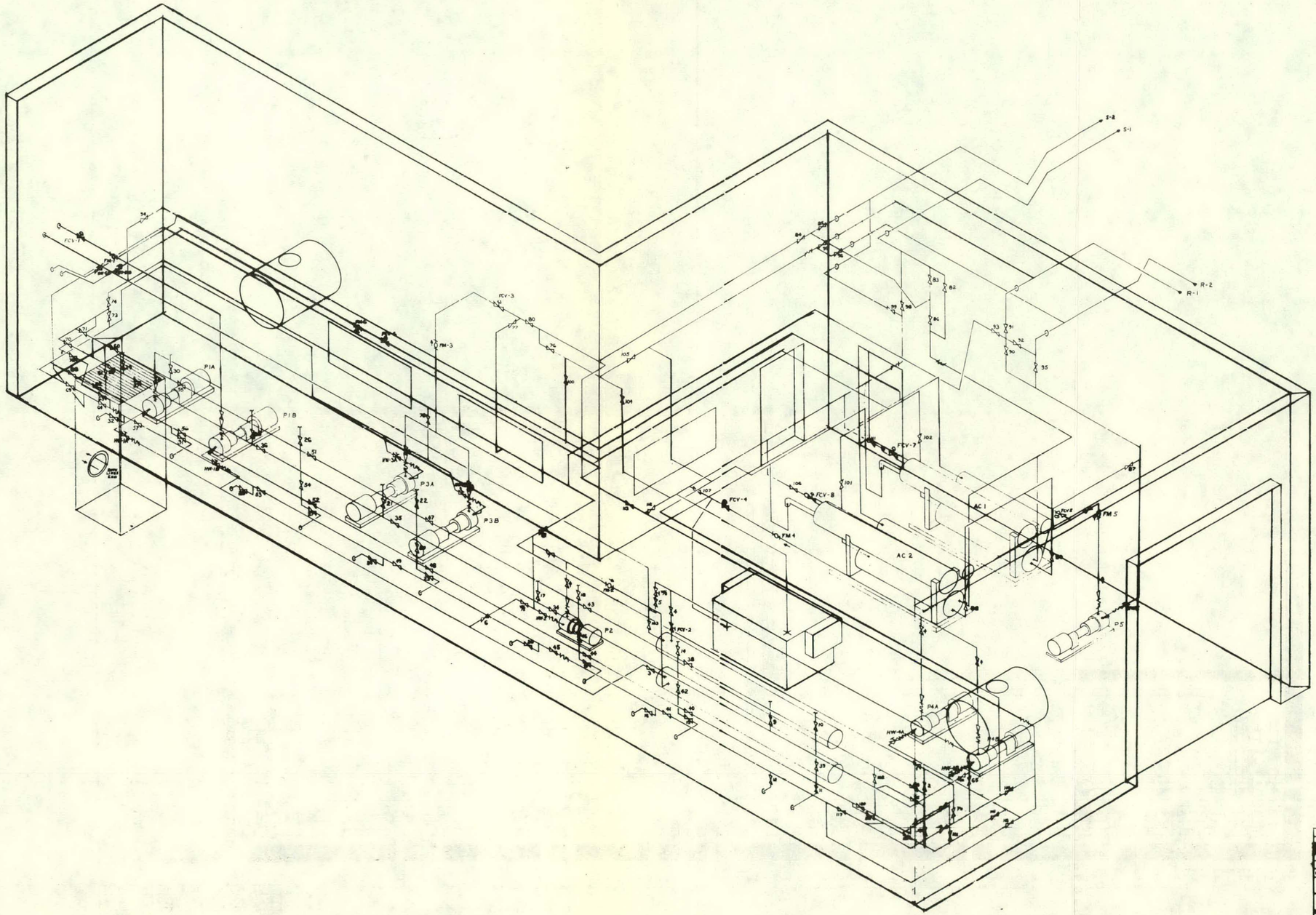
1) PANEL'S FRAME ASS'Y ~ (SEE DWG.# S-H-03-08-7-2)
1-A) COLLECTOR PANEL (SUNWORK DWG.# 10-3XXX-A)
2) SPOOL (HOSE-PANEL'S FRAME ASS'Y)-(SEE DWG.# S-H-03-11-7-1)
3) ARRAYS SUPPORT ASS'Y ~ END (SEE DWG.# S-H-03-07-7-1 / DETAIL # 2)
4) ARRAYS SUPPORT ASS'Y ~ INTERMEDIATE (SEE DWG.# S-H-03-07-7-1 / DETAIL # 1)
5) LATERAL BACK UP LEG FOR ARRAYS SUPPORT ASSY (SEE DWG.# S-H-03-08-7-1)
6) BEARING ASS'Y (SEE DWG.# S-H-03-17-7-1)
7) DRIVE MOTOR ~ MORSE #60 GCLV-DBL. REDUCTION ~ GEARMOTOR REDUCER
6°C.D. / 1000 RATIO / 23,000 IN.-LBS TORQUE / 1 HP
NEMA FRAME 56C / 3 PHASE / 230-460 V. A.C. / ENCLOSED.~
8) SPROCKET~DRIVER ~ (MORSE, ANSI ROLLER CHAIN #120~1½" PITCH, SINGLE STRAND
15 TEETH ~ 7.215 PITCH DIA. # B1215)
9) SPROCKET~DRIVEN ~ (MORSE, ANSI ROLLER CHAIN #120~1½" PITCH, SINGLE STRAND
35 TEETH ~ 16.734 PITCH DIA. # B1235)
10) CHAIN ~ 120 ANSI ROLLER CHAIN ~ 1½" PITCH SINGLE STRAND
(MORSE #120 RIVET CHAIN)





NOTE: DRIVE ASS'Y (MOTOR~SPROCKETS~CHAIN) RATED @ 55,000 LB/IN.

REV		BY	DATE	APP'D
RKL CONTROLS INC.				
TITLE: ARRAYS ASS'Y (TYPICAL)				
SCALE 3/4" = 1'-0"	DRAWN JBG	DATE 5-15-77		
E.A.	APP'D	DATE		
CONSTRUCTION	S-H-03-15-7-1 (SH. 1 OF 2)			
CONVERSION				



E	FINAL REVISION		8-20-81
D	ADD PIPING TO AIR HEATER/ADD FM-1 TO FM-5	DC	7-28-81
C	RELOCATE ALL CHECK VALVES	DC	5-12-81 DC
B	REV. DUE TO COMP. PROG	PE	1-22-81 DC
A	CHANGED AIR-HANDLER FEED	DC	1-5-81 DC
ISSUE		BY	DATE APPD

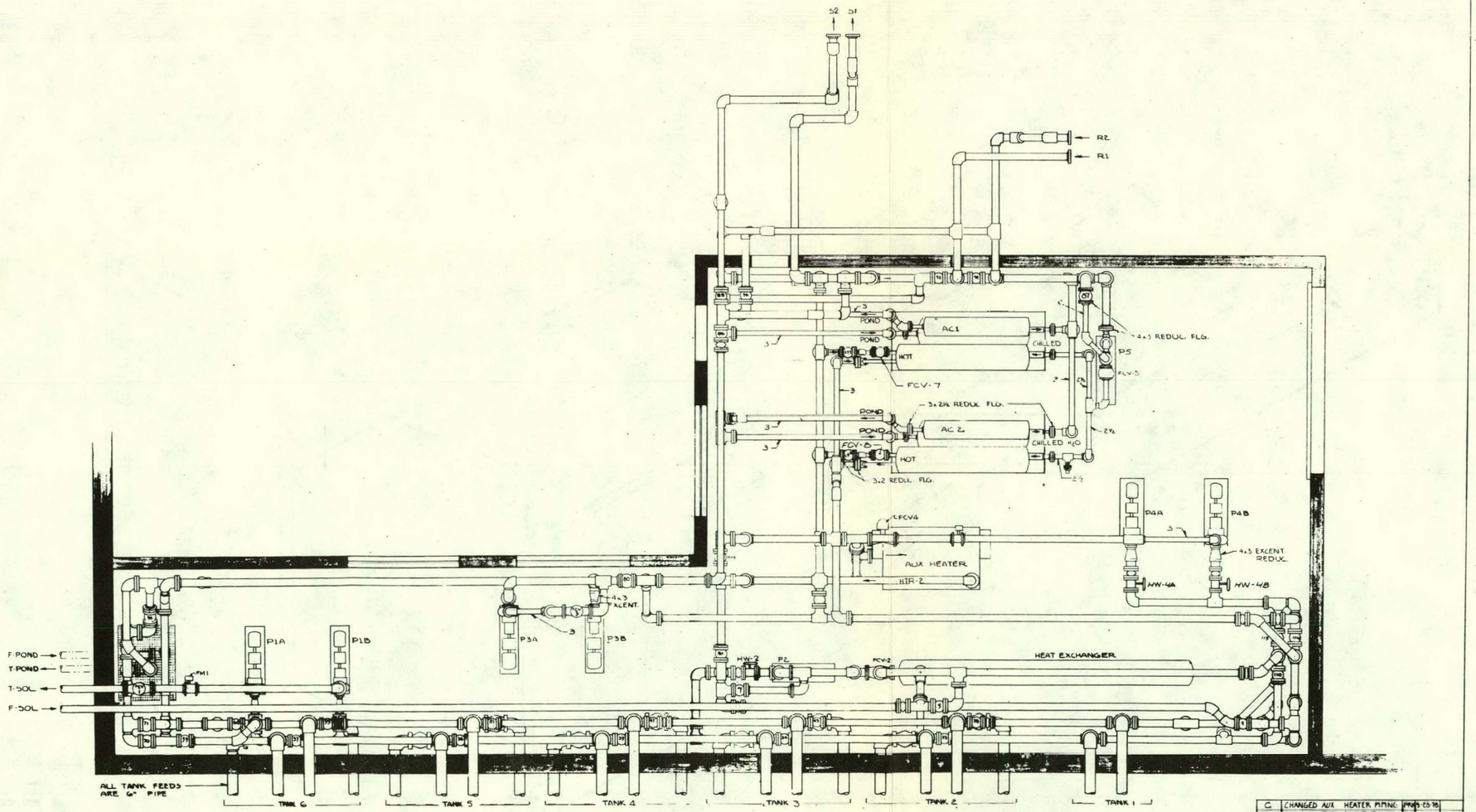
RKL CONTROLS INC.

MECHANICAL ROOM CONTROL

SCALE: NONE DRAWN BY: DATE: 8-12-81

APPD: DATE:

E-81003 E



1 - ALL PIPE IS 4" EXCEPT WHERE NOTED OTHERWISE.
2 - ALL NUMBERED VALVES ARE RKL-SG'S.

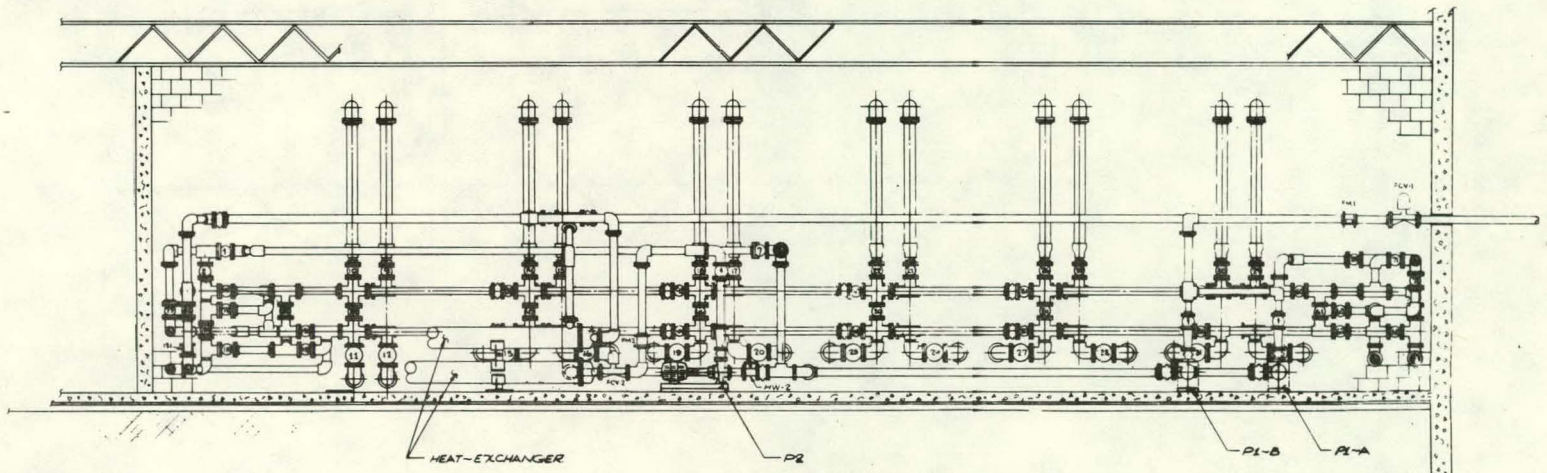
C	CHANGED AUX. HEATER PIPING	DAVID JG	2-23-78
B	REV. DUE TO COMP PROG	DS/4.28.78	DG
A	CHANGED MEHANDLER FEED	DAVE G.	8
REV		BY	DATE APPD

RKL CONTROLS INC.

TITLE: MECHANICAL ROOM - TOP VIEW

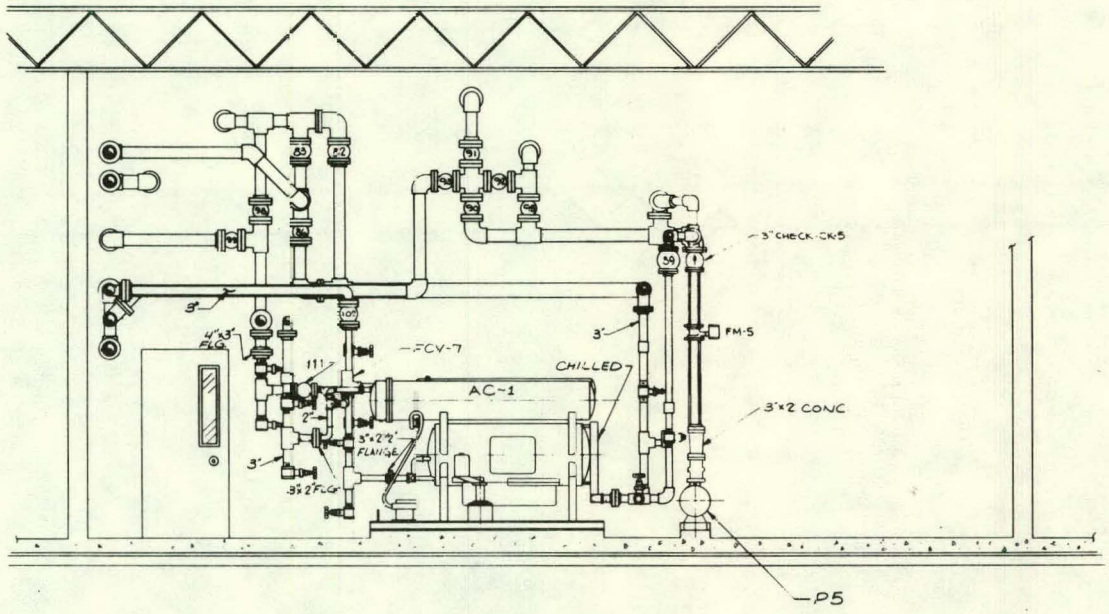
SCALE: 1/2" = 1' | DRAWN: DAVID JG | DATE: 2.23.78
CK'D: D. G | DATE: 2.23.78
NOVA | EN10000 | SHT 1/2 | C

NOTE: ALL PIPE 4" EXCEPT AS NOTED.
ALL NUMBERED VALVES ARE RKL-56'S.



SECTION "A-A"

RKL CONTROLS INC.
MECH. ROOM PIPING SEC. "A-A"
EN-10011



SECTION "C-C"

NOTES:

ALL PIPE 4" EXCEPT AS NOTED.
ALL NUMBERED VALVES ARE RKL SQ'S.

REV	DESCRIPTION	BY	DATE	APPD
A	REV. DUE TO COMP. PROG.	DS	4-9-78	DG

E. Position Change on Check Valve

TOLERANCES EXCEPT AS NOTED
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

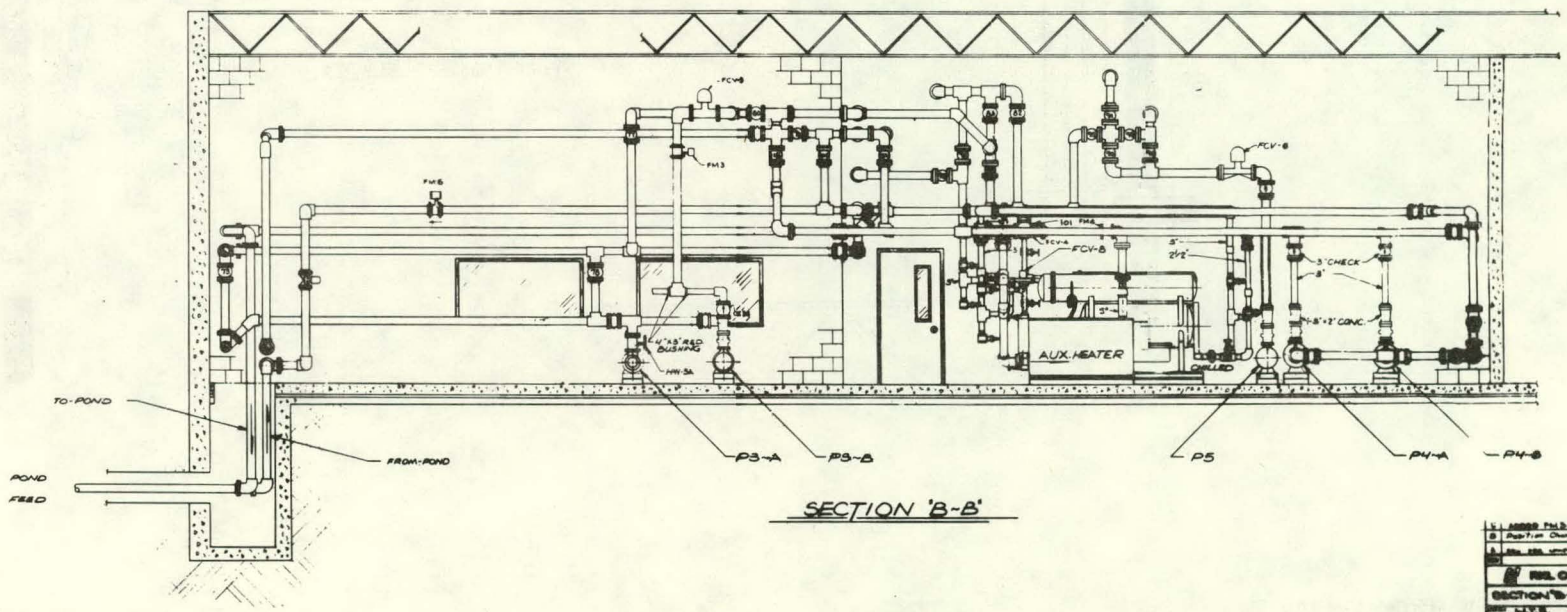
RKL CONTROLS INC.

TITLE: MECHANICAL ROOM PIPING

SCALE 1/2" = 1" | DRAWN D.L. DATE 3-2-78
E.A. DATE | APPD D.F. DATE 3 11 78
CUSTOMER NOVA

DN10003 B

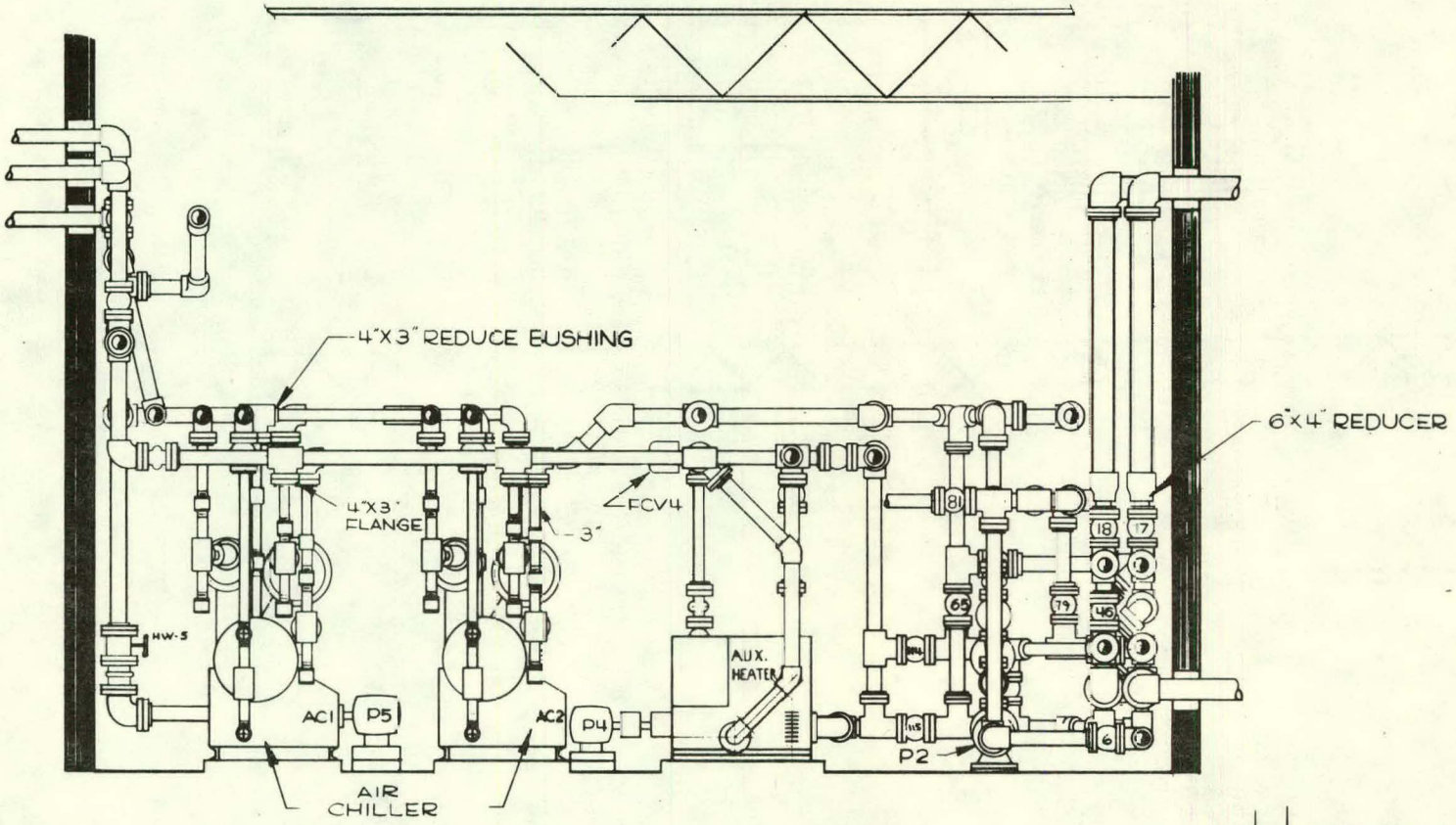
NOTE: 1 ALL PIPING ARE 4" UNLESS OTHERWISE NOTED.
2 ALL NUMBERED VALVES ARE RKL-53'S



SECTION 'B-B'

RKL CONTROLS INC.
SECTION "B-B" MECH. ROOM
DN-10006

NOTE; 1. ALL PIPING ARE 4" UNLESS OTHERWISE NOTED.
2. ALL NUMBERED VALVES ARE RKL-SG'S



SECTION D-D

REV		BY	DATE	APPD
B	CHANGED PIPING TO AUX. HEATER	TRH	9-28-78	
A	rev. Per Comments	DCL	8 22 78	DC

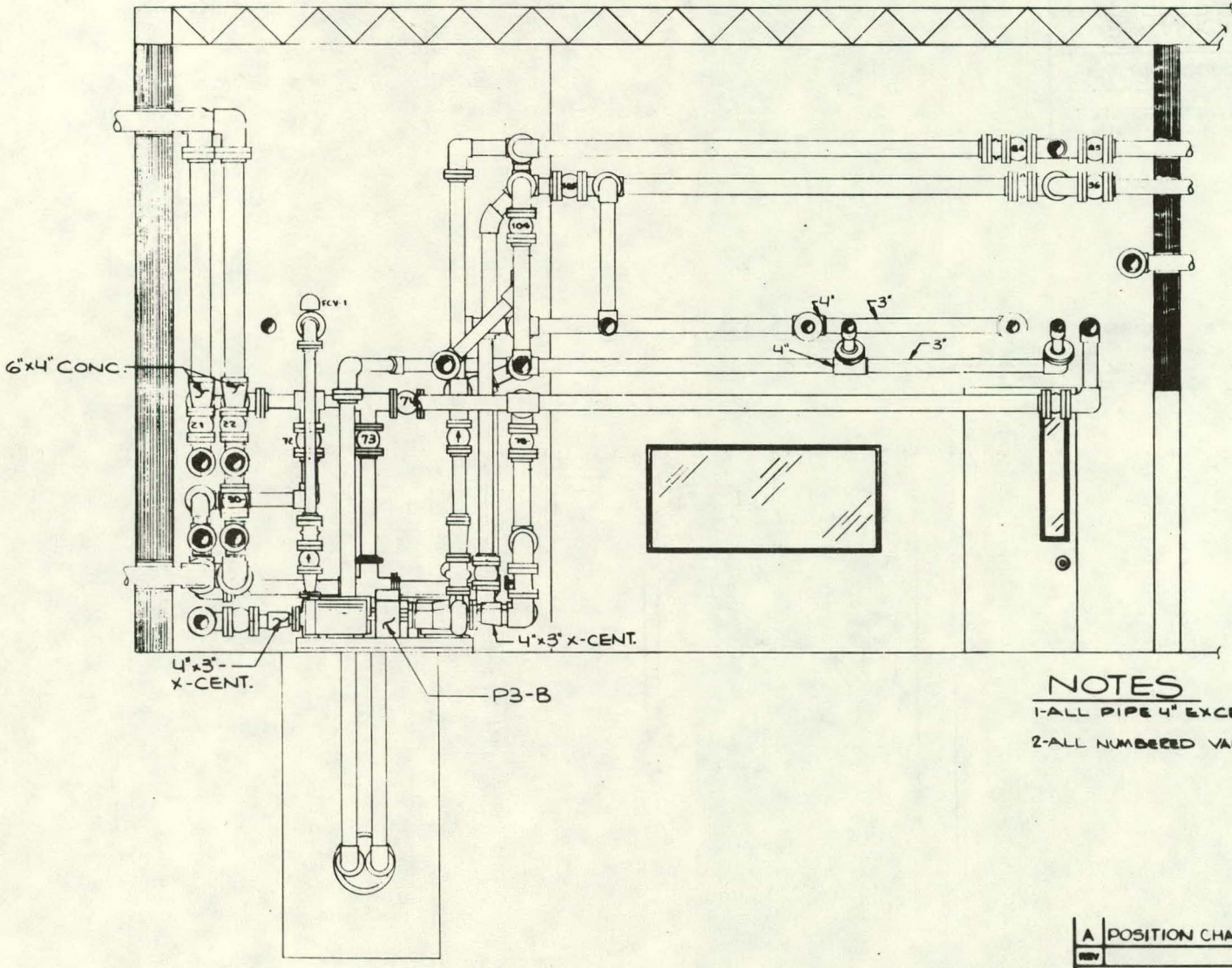
RKL CONTROLS INC.

TITLE
MECHANICAL ROOM PIPING

DRAWN 4. LE DATE Mar 15 78
APPD D.C. DATE 3 15 78

CN-10013 B

DATE	SYM	REVISION RECORD	AUTH	DR	CK



SECTION E-E

NOTES

1-ALL PIPE 4" EXCEPT AS NOTED.

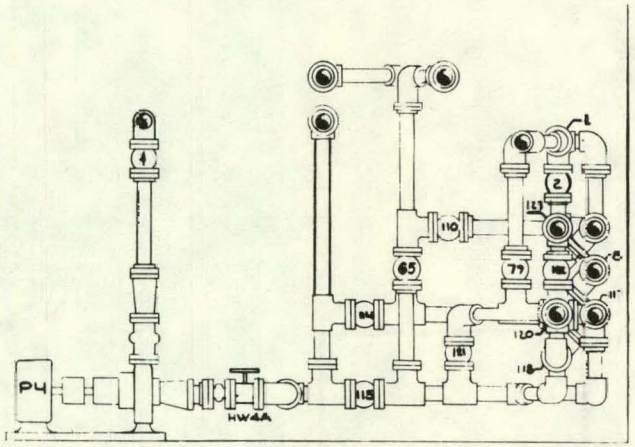
2-ALL NUMBERED VALVES ARE RKL BG's.

REV		BY	DATE	APPD
A	POSITION CHANGE ON CHECK V.	[illegible]	9-18-78	DG

RKL CONTROLS INC.

TITLE: MECHANICAL ROOM PIPING

SCALE 1/2" = 1'	DRAWN PAUL H.	DATE MAR 15 78
E.R.	APPD D. H. [illegible]	DATE 3-15-78
CONSTRUCTION	CN 10009	A



SECTION F-F

NOTES

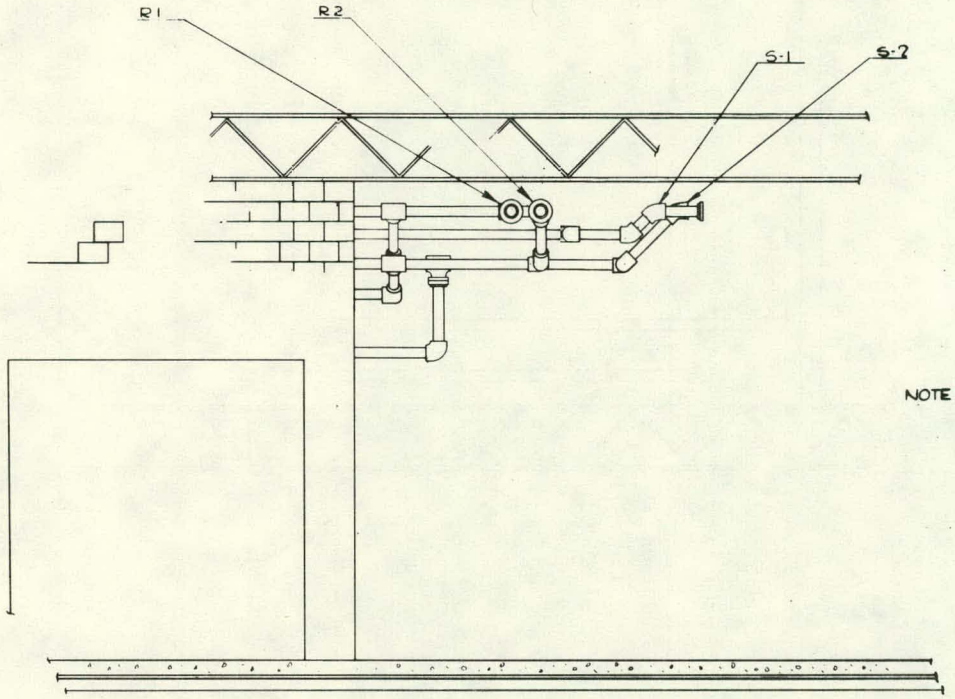
1- ALL PIPE 4" EXCEPT AS NOTED.
2- ALL NUMBERED VALVES ARE RKL SG'S.

REV		BY	DATE	APPD
B	INSTALLED CHECK VALVE.	JV DG	11-7	DG
A	REV. PER COMP REPROG.			

RKL CONTROLS INC.

MECHANICAL ROOM PIPING

SCALE 1/2" = 1' | DRAWN RICK G. DATE 12 15 78
APPD D. Hill DATE 3-15-79
CN-10008 B



NOTE; 1. ALL PIPING ARE 4" UNLESS OTHERWISE NOTED
2. ALL NUMBERED VALVES ARE RKL-SER

SECTION **G-G**

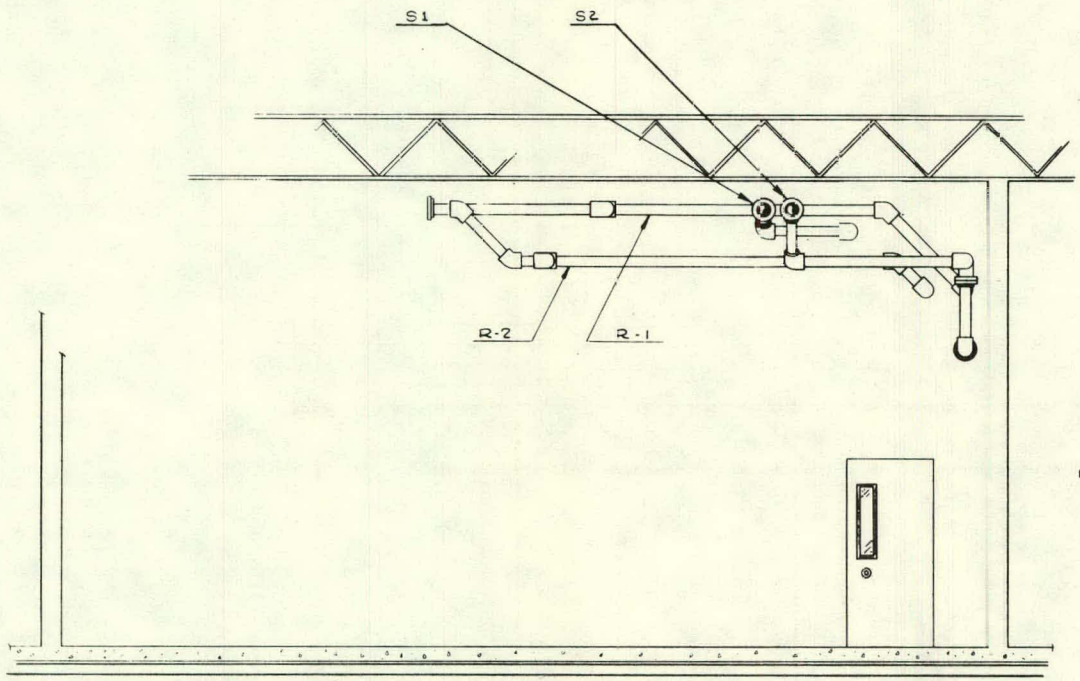
A CHANGED MECHANICAL EQUIPMENT

RKL CONTROLS INC.

MECHANICAL ROOM PIPING

SCALE 1/2" = 1"

DN-10007 A



SECTION **H-H**

NOTE: 1. ALL PIPING ARE 4" UNLESS OTHERWISE NOTED.
2. ALL NUMBERED VALVES ARE RKL-963

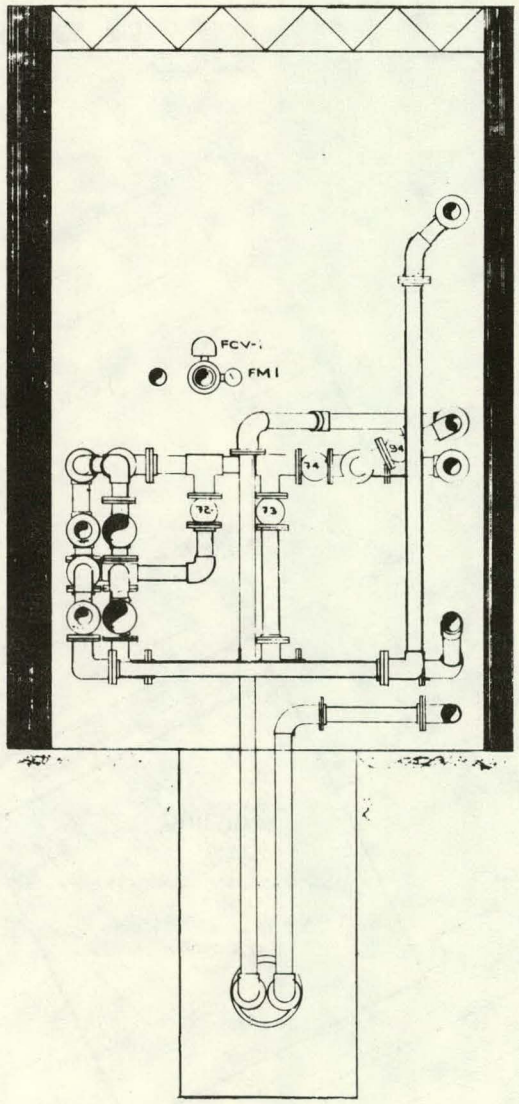
A	CHANGED AIR HANDLER FEEDS		
REV		BY	DATE

RKL CONTROLS INC.

TITLE: MECHANICAL ROOM PIPING

SCALE 1/2" = 1" | DRAWN J. LEE DATE 15 MAR 78
CHK'D | APP'D D. DATE 15 MAR 78
DRAWING NOVA | DN10004 | A

DATE	SYM	REVISION RECORD	AUTH	DR	CK

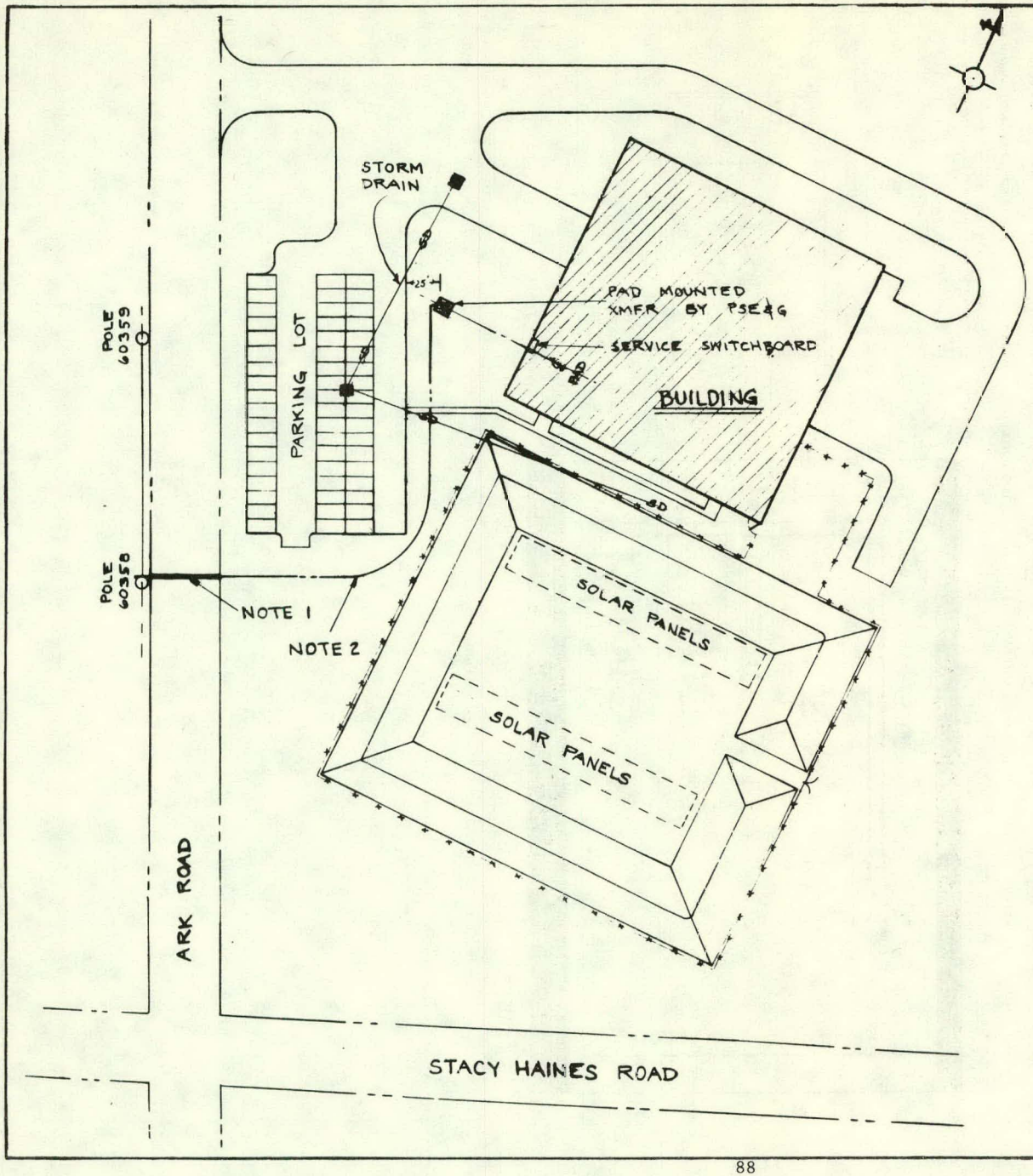


SECTION J-J

NOTES:

1- ALL PIPE 4" EXCEPT AS NOTED.
2- ALL NUMBERED VALVES ARE RKL SQ'S.

REV		BY	DATE	APPD
RKL CONTROLS INC.				
TITLE: MECHANICAL ROOM PIPING				
SCALE 1/2" = 1'	DRAWN PAUL H.	DATE MAR 13 78		
E.A.	APPD D.	DATE 3/15/78		
CUSTOMER	CN 10002			



NOTES

1. CONTRACTOR SHALL PROVIDE 4" CONDUIT UNDER STREET, GRC OR PVC.
2. 3-1/0 15 KV POLY CABLE UG, AS SHOWN BY DWGS, BY PS AT PS EXPENSE. TRENCHING BY PS AT OWNER'S EXPENSE.
3. PULL PARALLELED SECONDARY LATERALS IN NUMBERED CONDUITS IN THE FOLLOWING NUMBERED ORDER, AS MAY BE APPLICABLE: 1, 2, 5, 6, 3, 7, 4, 8.

REFERENCES:

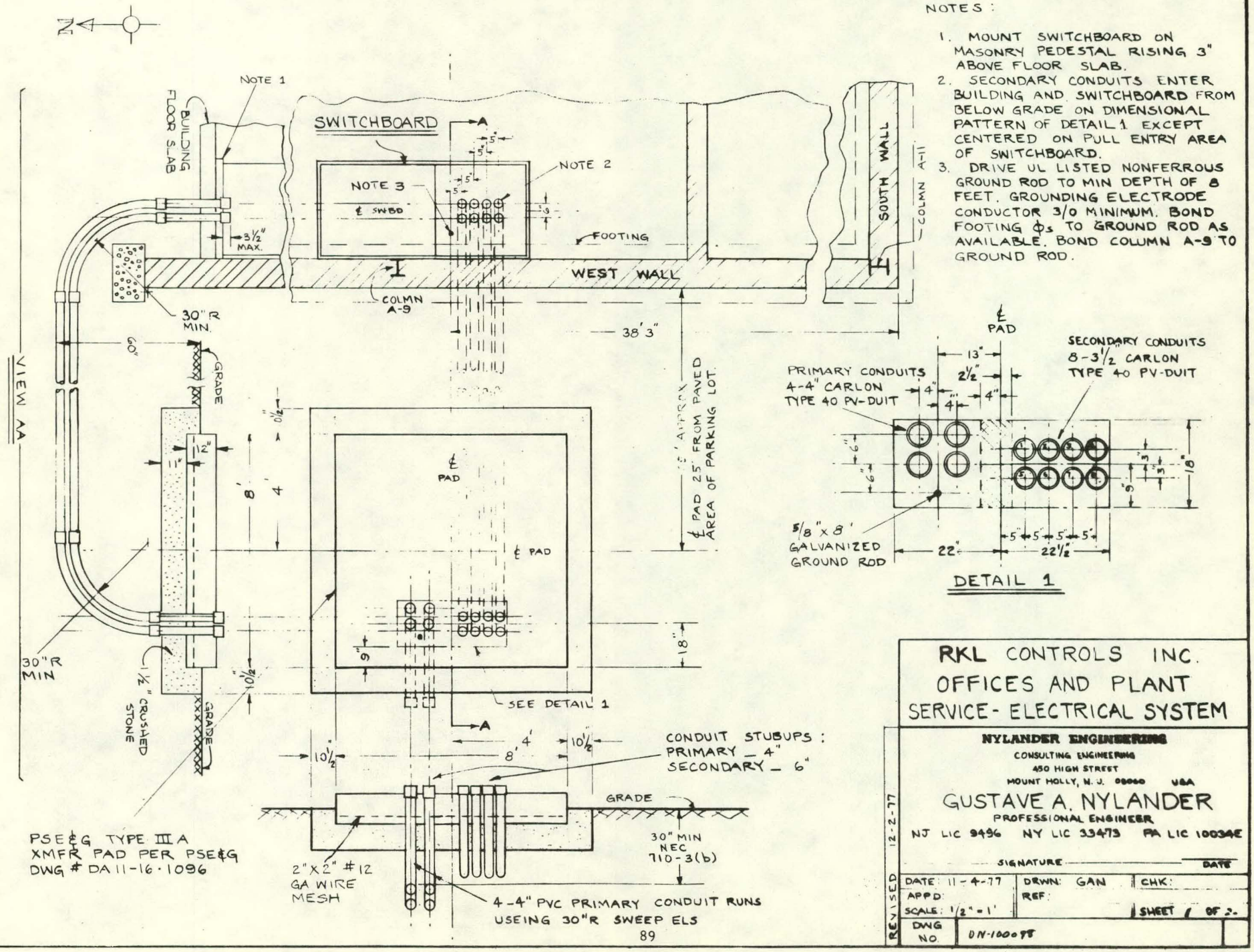
(1) PSE&G SKETCH S-832 DATED 9/7/77, ENTITLED RKL CONTROL INC., (2) DIAGRAM OF TYPICAL INSTALLATION 3Φ PADMOUNTED XMFRS DWG H-2172-A, DATED 2/23/75, (3) SPECS FOR CUSTOMER INSTALLED UNDERGROUND SERVICE CONDUIT DWG N-2031, DATED 6/1/77, (4) SERVICE RUNS _ SECONDARY CONNECTIONS TO PS EQUIPMENT WI 3.6.1-7, DATED 7/1/75, (5) SERVICE RUNS _ 3Φ PAD MOUNTED XMFR INSTALLATIONS OH ZONE DWG H-2172, DATED 8/1/76

RKL CONTROLS INC.
OFFICES AND PLANT
SERVICE - ELECTRICAL SYSTEM

NYLANDER ENGINEERING
CONSULTING ENGINEERING
450 HIGH STREET
MOUNT HOLLY, N.J. 08060
GUSTAVE A. NYLANDER
PROFESSIONAL ENGINEER
NJ LIC 9486 NY LIC 33473 PA LIC 10884E

SIGNATURE _____ DATE

DATE: 11-4-77	DRWN: GAN	CHK:
APPD:	REF:	
SCALE: 50:1		[redacted]
DWG NO. DN-10009		



NOTES :

1. MOUNT SWITCHBOARD ON MASONRY PEDESTAL RISING 3" ABOVE FLOOR SLAB.
2. SECONDARY CONDUITS ENTER BUILDING AND SWITCHBOARD FROM BELOW GRADE ON DIMENSIONAL PATTERN OF DETAIL 1 EXCEPT CENTERED ON PULL ENTRY AREA OF SWITCHBOARD.
3. DRIVE UL LISTED NONFERROUS GROUND ROD TO MIN DEPTH OF 8 FEET. GROUNDING ELECTRODE CONDUCTOR 3/0 MINIMUM. BOND FOOTING ϕs TO GROUND ROD AS AVAILABLE. BOND COLUMN A-9 TO GROUND ROD.

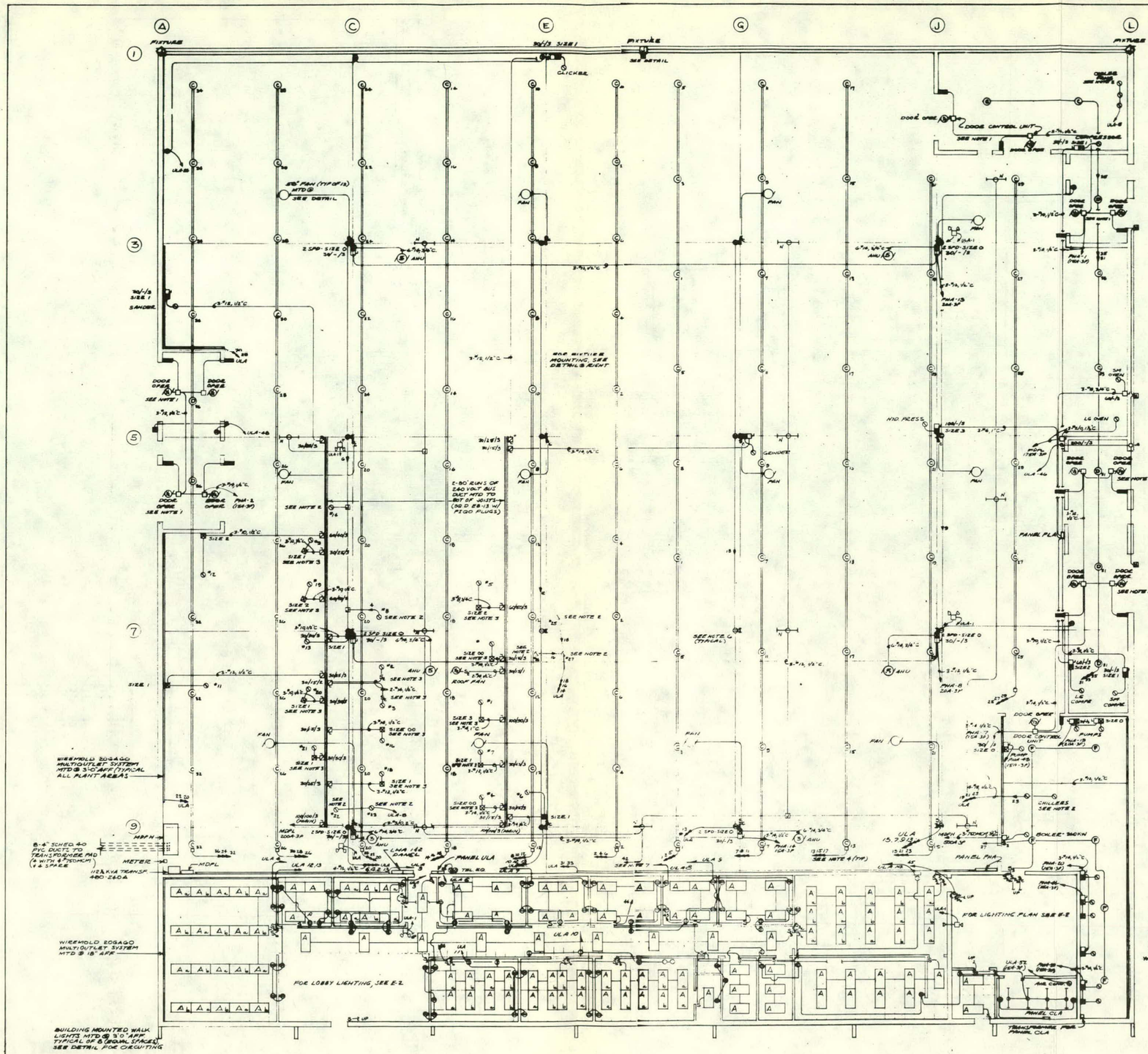
RKL CONTROLS INC.
OFFICES AND PLANT SERVICE- ELECTRICAL SYSTEM

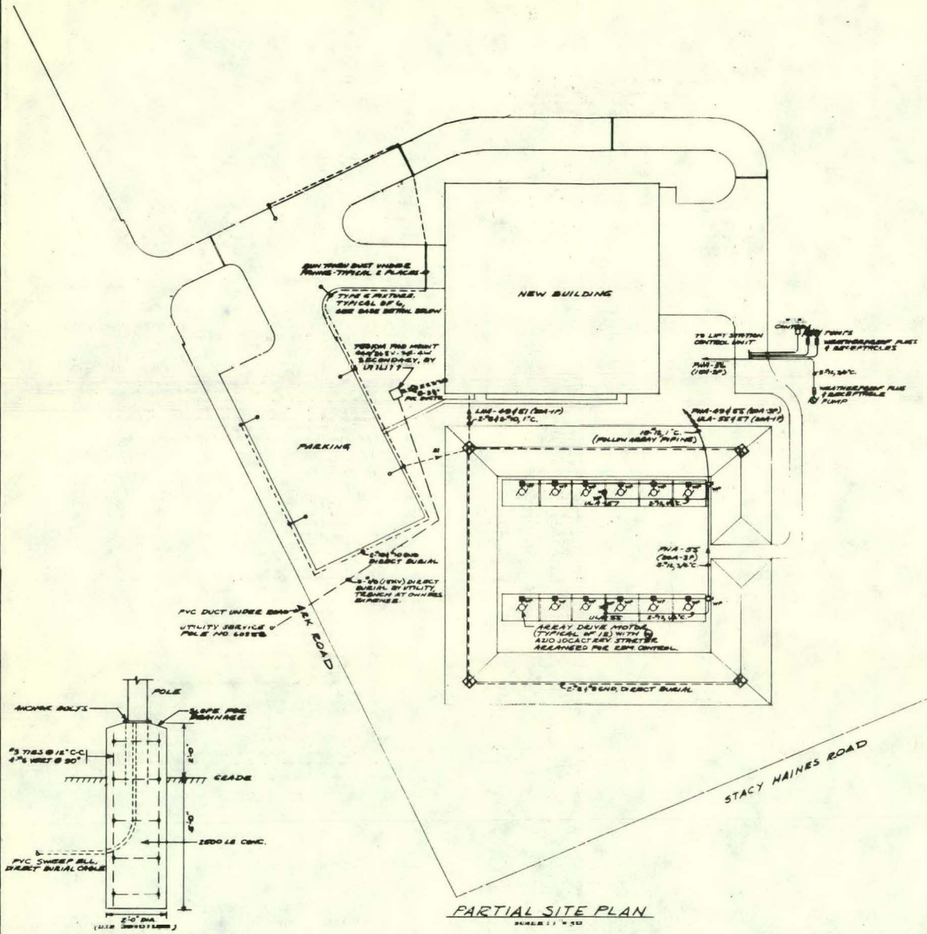
NYLANDER ENGINEERING
CONSULTING ENGINEERING
450 HIGH STREET
MOUNT HOLLY, N. J. 08060 USA
GUSTAVE A. NYLANDER
PROFESSIONAL ENGINEER
NJ LIC 9496 NY LIC 33473 PA LIC 10034E

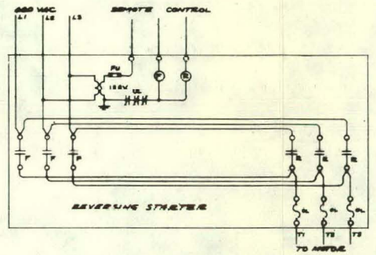
SIGNATURE _____ DATE

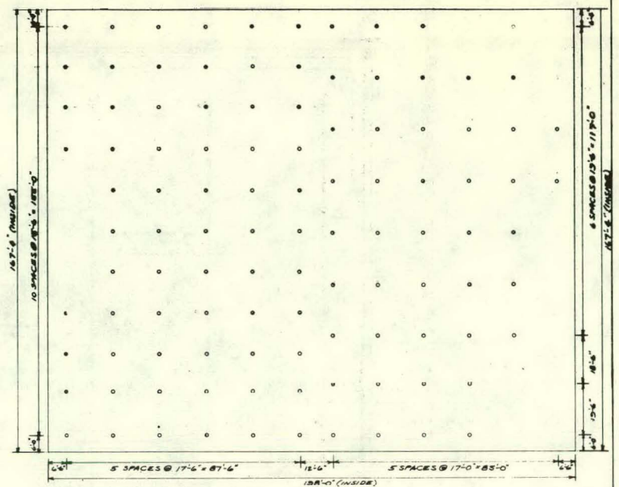
DATE: 11-4-77	DRWN: GAN	CHK:
APP'D:	REF:	
SCALE: 1/2"=1'		SHEET 1 OF 2.
DWG NO.	DN-100078	

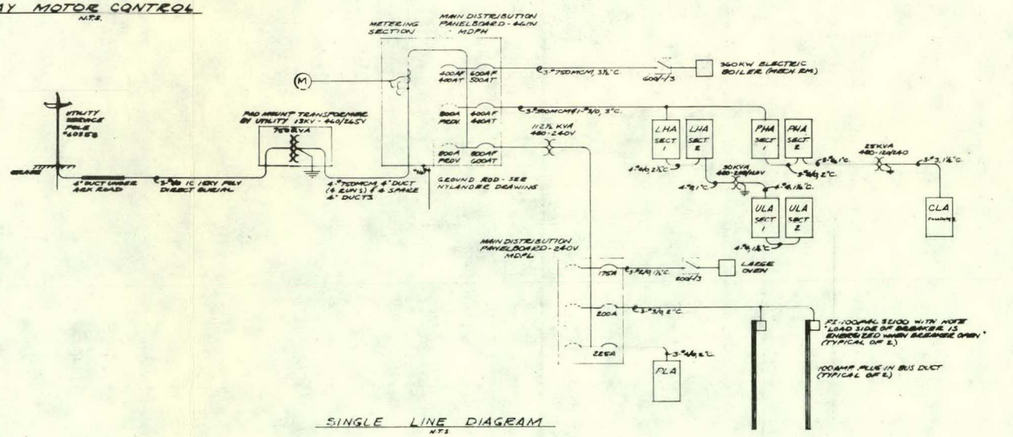
REVISED 12-2-77

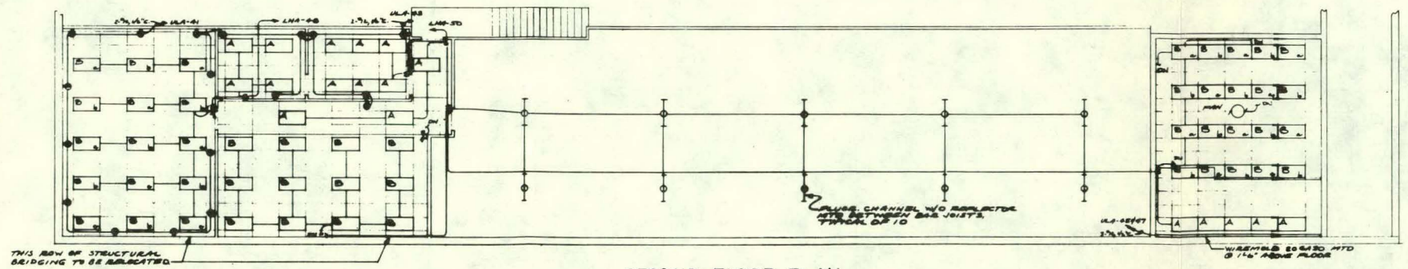

FIXTURE
CLICKER
SEE DETAIL
DOOR OPEN
DOOR CONTROL UNIT
SEE NOTE 1
FAN
2 SPD-SIZE 0
30A/-/3
AHU
SIZE 1
SIZE 2
SIZE 3
SIZE 00
SIZE 0

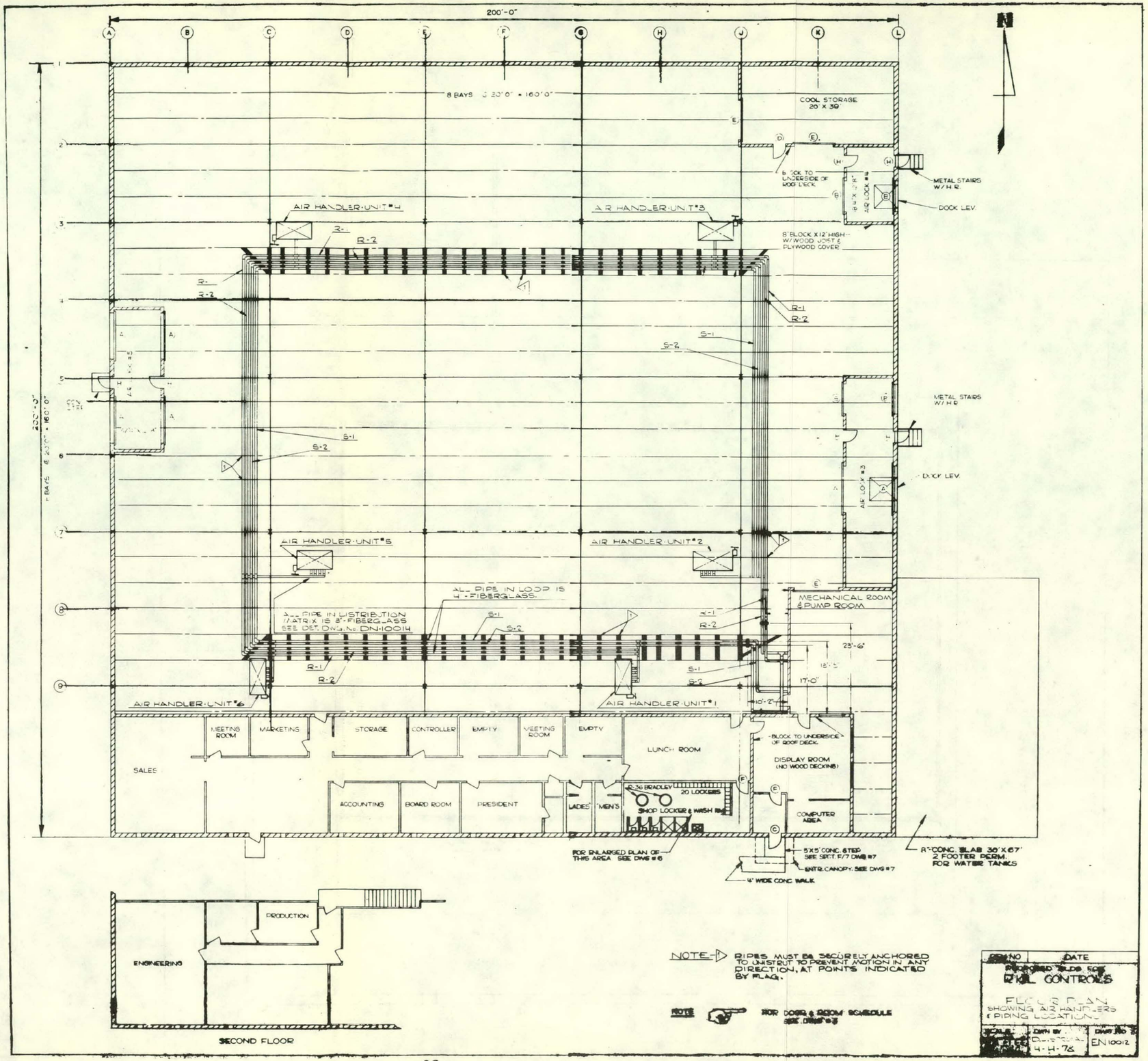

NEW BUILDING
PARKING
ARK ROAD
STACY HAINES ROAD
TYP 4 RATING, TYPICAL OF 4, SEE SHT DETAIL BELOW
PVC DUCT UNDER ROAD
UTILITY SERVICE POLE NO. 10198
ARRAY DRIVE MOTOR (TYPICAL OF 18) WITH AUXILOCAT REV. STARTER, REARMED PVC EXPO CONTROL
2-3"Ø GVR DIRECT BURIAL
POLE
ANCHOR BOLTS
GRADE
2500 LB CONC.
PVC SWEEP ELL, DIRECT BURIAL CABLE
PARTIAL SITE PLAN
POLE BASE DETAIL

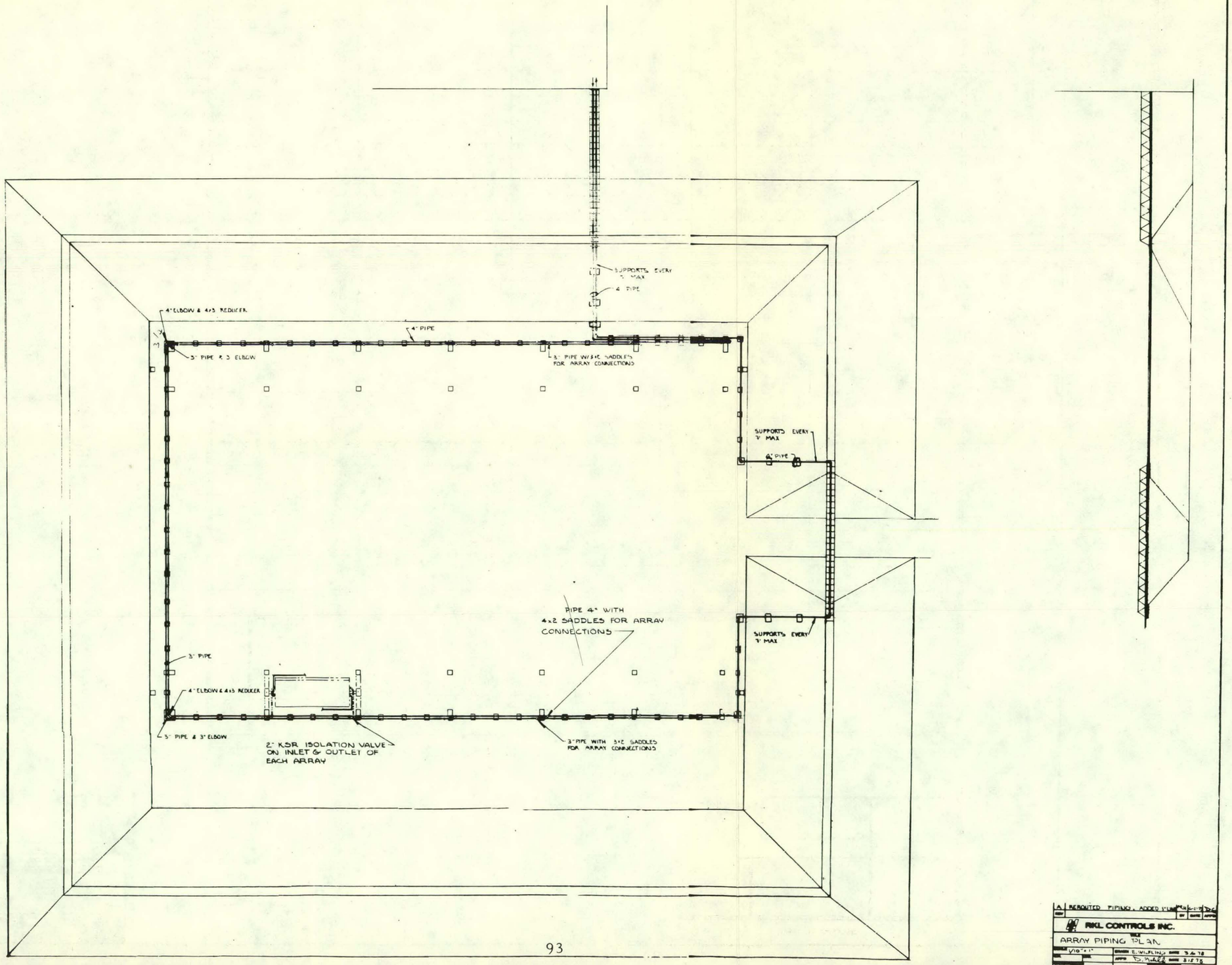

480 VAC
REMOTE CONTROL
REVERSING STARTER
TO MOTOR
ARRAY MOTOR CONTROL


5 SPACES @ 17'-6" = 87'-6"
15'-0"
5 SPACES @ 17'-0" = 85'-0"
180'-0" (INSIDE)
10 SPACES @ 16'-8" = 166'-8"
LIGHTING LAYOUT


METERING SECTION
MAIN DISTRIBUTION PANEL BOARD - MAIN MDPN
480 VOLT UTILITY SERVICE POLE #10198
4" DUCT UNDER ARK ROAD
4" DUCT UNDER ROAD - SEE NTL ANDEC DRAWING
GROUND ROD - SEE NTL ANDEC DRAWING
360KW ELECTRIC BOILER (MECH RM)
LHA SECT 1
LHA SECT 2
PHA SECT 1
PHA SECT 2
ULA SECT 1
ULA SECT 2
CLA
LARGE OVEN
FE-100AMP 3E/100 WITH NOTE "LOAD SIDE OF BREAKER IS ENERGIZED WHEN BREAKER OPEN" (TYPICAL OF 2)
100AMP PLUG IN BUS DUCT (TYPICAL OF 6)
SINGLE LINE DIAGRAM


LHA-66
LHA-55
LHA-33
ULA-55
ULA-44
ULA-33
ULA-22
ULA-11
LHA-11
LHA-22
LHA-44
LHA-55
LHA-66
LHA-77
LHA-88
LHA-99
LHA-1010
LHA-1111
LHA-1212
LHA-1313
LHA-1414
LHA-1515
LHA-1616
LHA-1717
LHA-1818
LHA-1919
LHA-2020
LHA-2121
LHA-2222
LHA-2323
LHA-2424
LHA-2525
LHA-2626
LHA-2727
LHA-2828
LHA-2929
LHA-3030
LHA-3131
LHA-3232
LHA-3333
LHA-3434
LHA-3535
LHA-3636
LHA-3737
LHA-3838
LHA-3939
LHA-4040
LHA-4141
LHA-4242
LHA-4343
LHA-4444
LHA-4545
LHA-4646
LHA-4747
LHA-4848
LHA-4949


200'-0"
8 BAYS @ 20'-0" = 160'-0"
200'-0"
10 BAYS @ 20'-0" = 160'-0"
COOL STORAGE 20' X 30'
BLOCK TO UNDERSIDE OF ROOF DECK
AIR LOCK #2
METAL STAIRS W/ H.R.
DOCK LEV.
AIR HANDLER-UNIT #4
AIR HANDLER-UNIT #3
8" BLOCK X 12" HIGH W/ WOOD JOIST & PLYWOOD COVER
R-1
R-2
S-1
S-2
AIR LOCK #3
METAL STAIRS W/ H.R.
DOCK LEV.
AIR HANDLER-UNIT #5
AIR HANDLER-UNIT #2
ALL PIPE IN LOOP IS 4" FIBERGLASS.
ALL PIPE IN DISTRIBUTION MATRIX IS 3" FIBERGLASS SEE DET. DWG. No DN-10014
MECHANICAL ROOM & PUMP ROOM
23'-6"
18'-0"
17'-0"
10'-2"
AIR HANDLER-UNIT #6
AIR HANDLER-UNIT #1
MEETING ROOM
MARKETING
STORAGE
CONTROLLER
EMPTY
MEETING ROOM
EMPTY
LUNCH ROOM
BLOCK TO UNDERSIDE OF ROOF DECK
DISPLAY ROOM (NO WOOD DECKING)
SALES
ACCOUNTING
BOARD ROOM
PRESIDENT
LADIES'
MEN'S
36" BRADLEY 20 LOCKERS
SHOP LOCKER & WASH BASIN
COMPUTER AREA
FOR ENLARGED PLAN OF THIS AREA SEE DWG # 6
5'X5' CONC. STEP SEE SECT. F/7 DWG #7
ENTR. CANOPY. SEE DWG #7
4" WIDE CONC. WALK
8" CONC. SLAB 30'X 67' 2 FOOTER PERIM. FOR WATER TANKS
PRODUCTION
ENGINEERING
SECOND FLOOR
NOTE- PIPES MUST BE SECURELY ANCHORED TO UNISTRUT TO PREVENT MOTION IN ANY DIRECTION, AT POINTS INDICATED BY FLAG.
NOTE FOR DOOR & ROOM SCHEDULE SEE DWG # 3
NO
DATE
REVISED SLAB FOR RHL CONTROLS
FLOOR PLAN SHOWING AIR HANDLERS & PIPING LOCATIONS
SCALE
DRAWN BY
4-4-76
DWG NO
EN 10012

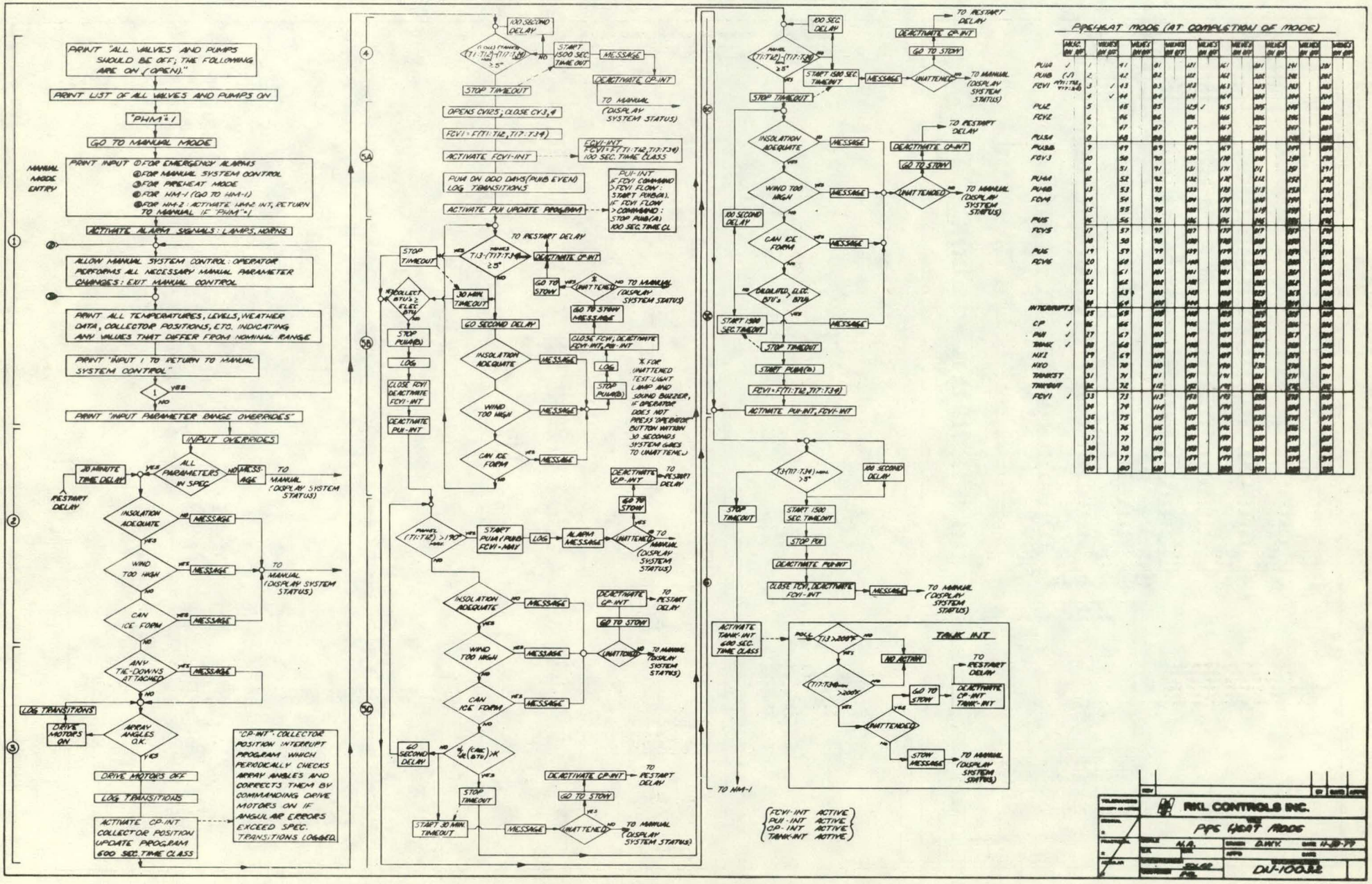


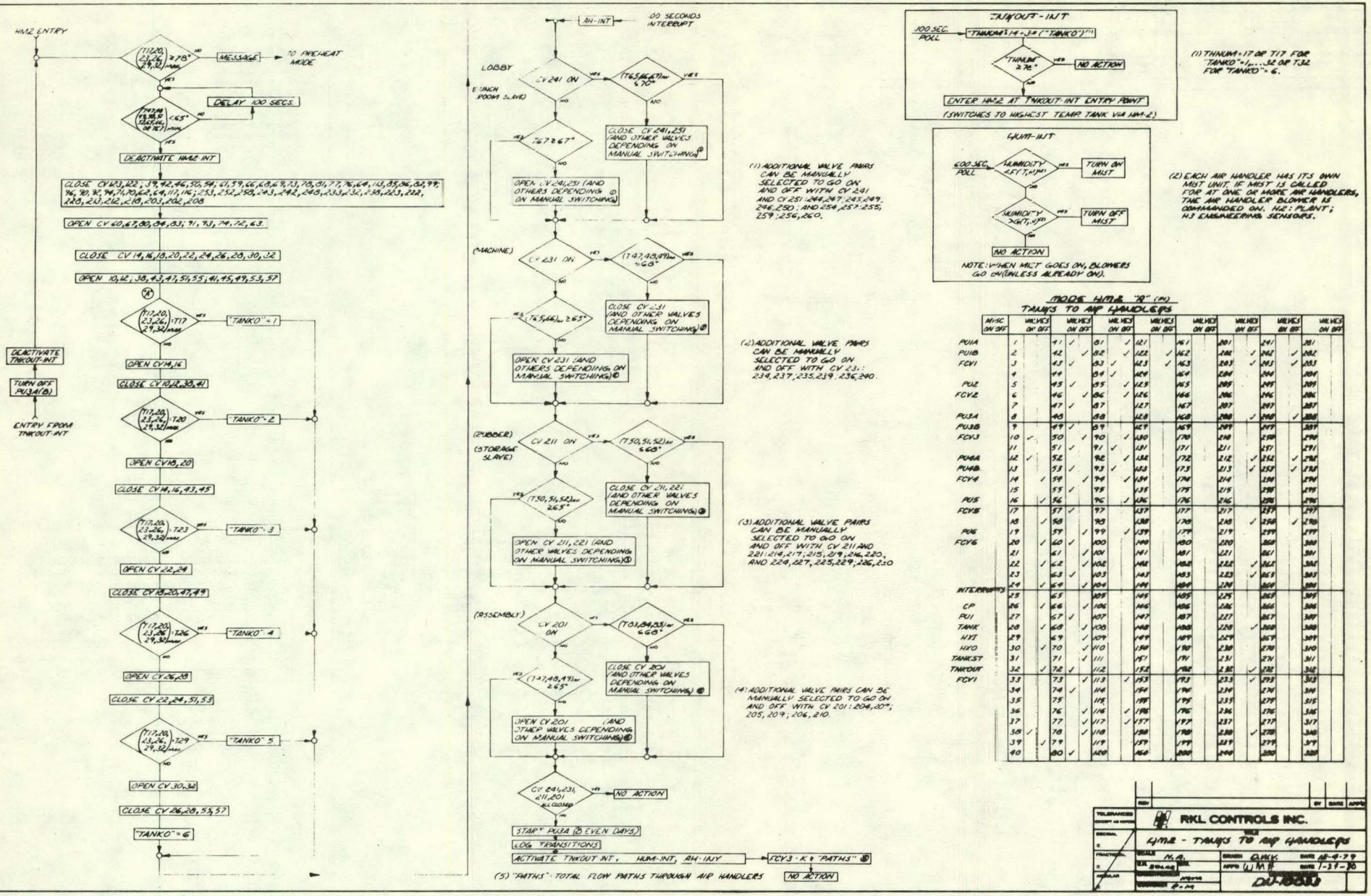
A	REROUTED PIPING + ADDED VLVS	KR	3-6-78
		BY	DATE

RKL CONTROLS INC.

ARRAY PIPING PLAN

SIZE	DRAWN E.WILKINS	3-6-78
A	APPD S.Mullen	3-17-78
NOVA	EN 10005	


PRINT "ALL VALVES AND PUMPS SHOULD BE OFF; THE FOLLOWING ARE ON (OPEN)."
PRINT LIST OF ALL VALVES AND PUMPS ON
"PHM" = 1
GO TO MANUAL MODE
MANUAL MODE ENTRY
PRINT INPUT ① FOR EMERGENCY ALARMS ② FOR MANUAL SYSTEM CONTROL ③ FOR PREHEAT MODE ④ FOR HM-1 (GO TO HM-1) ⑤ FOR HM-2: ACTIVATE HM-2 INT, RETURN TO MANUAL IF "PHM" = 1
ACTIVATE ALARM SIGNALS: LAMPS, HORNS
ALLOW MANUAL SYSTEM CONTROL: OPERATOR PERFORMS ALL NECESSARY MANUAL PARAMETER CHANGES: EXIT MANUAL CONTROL
PRINT ALL TEMPERATURES, LEVELS, WEATHER DATA, COLLECTOR POSITIONS, ETC. INDICATING ANY VALUES THAT DIFFER FROM NOMINAL RANGE
PRINT "INPUT 1 TO RETURN TO MANUAL SYSTEM CONTROL"
PRINT "INPUT PARAMETER RANGE OVERRIDES"
INPUT OVERRIDES
20 MINUTE TIME DELAY
ALL PARAMETERS IN SPEC
MESSAGE
TO MANUAL (DISPLAY SYSTEM STATUS)
RESTART DELAY
INSOLATION ADEQUATE
WIND TOO HIGH
CAN ICE FORM
ANY TIE-DOWNS ATTACHED
LOG TRANSITIONS
DRIVE MOTORS ON
ARRAY ANGLES O.K.
DRIVE MOTORS OFF
LOG TRANSITIONS
ACTIVATE CP-INT COLLECTOR POSITION UPDATE PROGRAM 600 SEC. TIME CLASS
"CP-INT": COLLECTOR POSITION INTERRUPT PROGRAM WHICH PERIODICALLY CHECKS ARRAY ANGLES AND CORRECTS THEM BY COMMANDING DRIVE MOTORS ON IF ANGULAR ERRORS EXCEED SPEC. TRANSITIONS LOGGED
100 SECOND DELAY
START 1500 SEC. TIMEOUT
STOP TIMEOUT
OPENS CV125; CLOSE CV3, 4
FCV1 = F(T11:T12, T17:T34)
ACTIVATE FCV1-INT
FCV1-INT: FCV1=F(T11:T12, T17:T34) 100 SEC. TIME CLASS
PUH ON 000 DAYS (PUHB EVEN) LOG TRANSITIONS
ACTIVATE PUH UPDATE PROGRAM
PUH-INT: IF FCV1 COMMAND > FCV1 FLOW: START PUH(B). IF FCV1 FLOW > COMMAND: STOP PUH(A) 100 SEC. TIME CL
TO RESTART DELAY
T13-(T17:T34) > 2.5°
DEACTIVATE CP-INT
GO TO STOW
% UNATTENDED
TO MANUAL (DISPLAY SYSTEM STATUS)
STOP PUMP(S)
30 MIN TIMEOUT
GO SECOND DELAY
GO TO STOW MESSAGE
CLOSE FCV1; DEACTIVATE FCV1-INT, PUH-INT
LOG
CLOSE FCV1 DEACTIVATE FCV1-INT
DEACTIVATE PUH-INT
% FOR UNATTENDED TEST-LIGHT LAMP AND SOUND BUZZER, IF OPERATOR DOES NOT PRESS 'OPERATOR' BUTTON WITHIN 30 SECONDS SYSTEM GOES TO UNATTENDED
INSOLATION ADEQUATE
WIND TOO HIGH
CAN ICE FORM
MESSAGE
T11:T12 > 190°F
START PUMP(S) FCV1-ARAY
ALARM MESSAGE
ANY (T11:T12) > 190°F
ANY (ARC/dt or BTU/dt) > K
START 30 MIN TIMEOUT
ACTIVATE PUH-INT, FCV1-INT
ACTIVATE TANK-INT 600 SEC. TIME CLASS
T13 > 200°F
TANK INT
NO ACTIVITY
(T17:T34) > 200°F
STOW MESSAGE
TO HM-1
FCV1-INT ACTIVE
PUH-INT ACTIVE
CP-INT ACTIVE
TANK-INT ACTIVE
PREHEAT MODE (AT COMPLETION OF MODE)
ARC/dt BIT
VALVES BIT
PUH4
PUH8
FCV1
PUH2
FCV2
PUH1
PUH8
FCV3
PUH1
PUH8
FCV4
PUH5
FCV5
PUH6
FCV6
INTERRUPTS
CP
PUH
TANK
HX1
HX0
TANKRST
TIMEOUT
FCV1
RKL CONTROLS INC.
PIPE HEAT MODE
DWG. NO. DW1-10032



(1) ADDITIONAL VALVE PAIRS CAN BE MANUALLY SELECTED TO GO ON AND OFF WITH CV 241 AND CV 251: 244, 247, 245, 249, 248, 250; AND 254, 257, 255, 259; 256, 260.

(2) ADDITIONAL VALVE PAIRS CAN BE MANUALLY SELECTED TO GO ON AND OFF WITH CV 231: 234, 237, 235, 239; 236, 240.

(3) ADDITIONAL VALVE PAIRS CAN BE MANUALLY SELECTED TO GO ON AND OFF WITH CV 211 AND 221: 214, 217, 215, 219, 216, 220, AND 224, 227, 225, 229, 226, 230

(4) ADDITIONAL VALVE PAIRS CAN BE MANUALLY SELECTED TO GO ON AND OFF WITH CV 201: 204, 207, 205, 209; 206, 210.

MORE HM2 "A" (H)
TRAYS TO AIR HANDLERS

	MISC ON OFF	VALVES ON	VALVES OFF	VALVES ON	VALVES OFF	VALVES ON	VALVES OFF	VALVES ON	VALVES OFF	VALVES ON	VALVES OFF	VALVES ON	VALVES OFF
PU1A	1		41 ✓		81 ✓		121		161		201		241		281	
PU1B	2		42	✓	82 ✓		122	✓	162		202	✓	242	✓	282	
FCV1	3		43 ✓		83 ✓		123	✓	163		203	✓	243	✓	283	
	4		44		84 ✓		124		164		204		244		284	
PU2	5		45 ✓		85	✓	125		165		205		245		285	
FCV2	6		46	✓	86	✓	126		166		206		246		286	
	7		47 ✓		87		127		167		207		247		287	
PU3A	8		48		88		128		168		208	✓	248	✓	288	
PU3B	9		49 ✓		89		129		169		209		249		289	
FCV3	10 ✓		50	✓	90	✓	130		170		210		250		290	
	11		51 ✓		91 ✓		131		171		211		251		291	
PU4A	12 ✓		52		92	✓	132		172		212	✓	252	✓	292	
PU4B	13		53 ✓		93 ✓		133		173		213	✓	253	✓	293	
FCV4	14	✓	54	✓	94	✓	134		174		214		254		294	
	15		55 ✓		95		135		175		215		255		295	
PU5	16	✓	56		96	✓	136		176		216		256		296	
FCV5	17		57 ✓		97		137		177		217		257		297	
	18	✓	58		98		138		178		218	✓	258	✓	298	
PU6	19		59	✓	99	✓	139		179		219		259		299	
FCV6	20	✓	60 ✓		100		140		180		220		260		300	
	21		61	✓	101		141		181		221		261		301	
	22	✓	62	✓	102		142		182		222	✓	262		302	
	23		63 ✓		103		143		183		223	✓	263		303	
INTERRUPTS	24	✓	64	✓	104		144		184		224		264		304	
	25		65		105		145		185		225		265		305	
CP	26	✓	66	✓	106		146		186		226		266		306	
PU1	27		67 ✓		107		147		187		227		267		307	
TANK	28	✓	68	✓	108		148		188		228	✓	268		308	
HXT	29		69	✓	109		149		189		229		269		309	
HXO	30	✓	70	✓	110		150		190		230		270		310	
TANKST	31		71	✓	111		151		191		231		271		311	
TNKOUT	32	✓	72 ✓		112		152		192		232	✓	272		312	
FCV1	33		73	✓	113	✓	153		193		233	✓	273		313	
	34		74 ✓		114		154		194		234		274		314	
	35		75		115		155		195		235		275		315	
	36		76	✓	116	✓	156		196		236		276		316	
	37		77	✓	117	✓	157		197		237		277		317	
	38 ✓		78	✓	118		158		198		238	✓	278		318	
	39	✓	79		119		159		199		239		279		319	
	40		80 ✓		120		160		200		240		280		320	

TOLERANCES EXCEPT AS NOTED	RKL CONTROLS INC.		
DECIMAL ±	TITLE HM2 - TRAYS TO AIR HANDLERS		
FRACTIONAL ±	SCALE N.S.	DRAWN CWK	DATE 12-6-79
ANGULAR ±	U.S. EQUIP.	APPD WJM	DATE 1-31-80
	MATERIAL	DWG. NO. DU-8830	
	FINISH		

(1) 9 36TPA + WIND SPEED + WIND DIR. + BAROM. PRESS. + PYRANOMETER

(2) 12 COLLECTOR POSITION

SLOT	CARD
1	ZPU
2	4FDC
3	TU-ART (TIMERS, INTERRUPT)
4	16K
5	16K
6	16K
7	8K
8	8K
9	D+7A
10	D+7A
11	D+7A
12	D+7A
13	8PIO
14	8PIO
15	8PIO
16	8PIO
* 17	8PIO

FLOPPY DISC. DRIVE

ADM TERMINAL

PDP-11

SILENT 700 PRINTS

DIGITAL PORT ADDRESSES	ANALOG PORT ADDRESSES		AVAIL	ACTUAL
7AI 400-104D	7 BRIDGE/MUX	105:111D	80	71 (T13:T86, T88:T93, T77:T74)
2AI 400-112D	3 BRIDGE/MUX	112:114D		
2AI 400-112D	2 BRIDGE/MUX	115,116D	16	12 (T1:T12)
1AI 400-112D	1 BRIDGE/MUX	117D	8	3
2AI 400-120D	2 VOLTAGE MUX	121,122D	16	13 (1)
2AI 400-120D	2 VOLTAGE MUX	123,124D	16	13 (2)
1AI 400-120D	1 VOLTAGE MUX	125D	8	6
7AO	7 ANALOG OUT	137:143D	7	6
6400-160D	256 TTL TO OAC5 INTERFACE	256 OAC5 ISOLATORS	320	2 ARKLA, 21 AIR HANDLERS, 24 ARRAYS, 11 PUMPS, 194 VALVES, 12 FANS, 1 BOILER, 2 THERMOSTAT BYPASS
6400-168D				
6400-176D				
6400-184D				
6401-192D				267

B	UPDATES		8-18-80
A	UPDATES		6-12-80 (D.M.H.)
REV		BY	DATE APP'D

TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

RKL CONTROLS INC.

SOLAR COMPUTER SYSTEM
COMPUTER BLOCK DIAGRAM

SCALE
DRAWN D.G.V. DATE 12-10-79
E.R. ENG.
APP'D W.M.K DATE 1-15-80
ORDER NUMBER
CUSTOMER
DRAWING NUMBER BM-10034

* NOT YET RECEIVED OR ORDERED.

DESN	DESCRIPTION	QUAN.	MANF. NAME TYPE	INPUT RANGE	OUTPUT RANGE	REQD. ACUR.	SAMPLING PERIOD	
MECHANICAL ROOM								
ANALOG INP.								
A	FLOW CONTROL 6	1	RKL/FOX BORO	0-200	4-20 MA		100	
	1,3,5	3	" "	0-300	4-20 MA		100	
	2	1	" "	0-400	4-20 MA		100	
	4	1	" "	0-500	4-20 MA		100	
B	TEMP SENSOR	19	OMEGA 35J3	0-212°F	±2.5 VDC	±1%	100	
H	TEMP SENSOR	4	OMEGA 35J3	0-212°F	±2.5 VDC	±1%	5	CHILLER
K	TEMP SENSOR	2	OMEGA 35J3	0-212°F	±2.5 VDC	±1%	5	BOILER
J	LOOP PRESSURE	3	OMEGA 205	0-30 PSI	0-5 VDC	±2%	30	
L	POWER USAGE	1					100	
	TOTAL	35						
ANALOG OUT								
F	FLOW CONTROL	6	RKL/BAILEY	4-20 MA	0-100% OPEN	±2%		SEE ITEMS A
	TOTAL	6						
DIGITAL OUT								
D	PUMP MOT. CONT.	9	WESTING HOUSE A1200 C.O	0-115 VAC LATCHING	0,440 3 Ø	—	—	
E	SG VALVES	12	RKL	0-115 VAC	OPEN, CLOSE	—	—	
K		6	RKL	0-115 VAC	CLOSE, OPEN	—		
G	APHILA PUMP	2	APHILA SOLAMAT 300	0-115 VAC	AC OFF AC ON	—	—	INTERNAL PROC. CONT.
I	BOILER CONTROL	1	PEERLESS	0-118 VAC	HT OFF HT ON	—	—	INTERNAL THERM. CONT.
	TOTAL	140						
POND								
ANALOG IN.								
B	TEMP SENSOR	3	OMEGA 35J3	0-212 F°	±2.5 VDC	±1%	100	
DIGITAL OUT								
A	PROPELLER CONT.	1	RKL	0-115 VAC	OFF, ON	—		
TANKS								
ANALOG IN.								
A	TEMP SENSOR	18	OMEGA 35J3	0-212°F	±2.5 VDC	±1%	100	3/TANK
B	PRESSURE TRANS.	6	SETRA 205	0-25 PSI	0-5 VDC	±1.5%	5	1/TANK
	TOTAL	24						

DESN	DESCRIPTION	QUAN.	MANF. NAME TYPE	INPUT RANGE	OUTPUT RANGE	REQD. ACUR.	SAMPLING PERIOD	
WEATHER STATION								
ANALOG INPUTS								
A	WIND SPEED	1	WEATHER MEAS. CORP.			1%	5	
B	WIND DIRECTION	1	WEATHER MEAS. CORP.			1%	5	
C	AMBIANT TEMP.	1	OMEGA 35J3			1%	600	
D	REL. HUMIDITY	1	PCRC-11			1%	60	
E	BAR PRESSURE	1				1%	100	
	TOTAL	5						
PLANT OFFICE								
ANALOG INP.								
A	REL. HUMIDITY	2	PCRC 11	0-100%RH	±2.5	±1%	100	
B	TEMP. SENSOR	12	OMEGA 35J3	0-212F°	±2.5	±1%	100	
G	TEMP. SENSOR	6	OMEGA 35J3	0-212F°	±2.5	±1%	100	
H	TEMP. SENSOR	3	OMEGA 35J3	0-212F°	±2.5	±1%	100	
	TOTAL	23						
DIGITAL OUT								
C	LOUVERS, A.H.	6	HALSTED MIDWAY	0, 115	EXT, INT	—	—	
D	HUMIDIFIER	6	"	0, 115	OFF, ON	—	—	
E	FAN HI	6	"	0, 115	50% OFF, ON	—	—	
V	FAN LOW	6	"	0, 115	50% OFF, ON	—	—	
F	SG, (SGE)	60	RKL/ASCO	115, 0	CLOSE, OPEN	—	—	
		8	RKL/ASCO	0, 115	OPEN, CLOSE	—	—	
	TOTAL	84						
BERM AREA								
ANALOG IN.								
A	PYRANOMETER	1	EPPLEY PSP	SCALLIGHT	0-14 MV		5	
B	TEMP. SENSOR	12	TEV IPC 4516B	0-350	±2.5 VDC	±1%	10	
C	POSITION INDICATOR	12	POT				.2 TO 10	
	TOTAL	25						
DIGITAL IN								
F	EDGE SENSOR	1	MICRO SWITCH	CONNECTED OR DISCONNECTED	0, 115	—	AS NEED UP	
DIGITAL OUT								
D	MOTOR FORWARD	12	A200 0,1	0, 115 VAC	OFF, ON	—	—	
G	MOTOR REVERSE	12	A200 0,1	0, 115 VAC	OFF, ON	—	—	
	TOTAL	24						

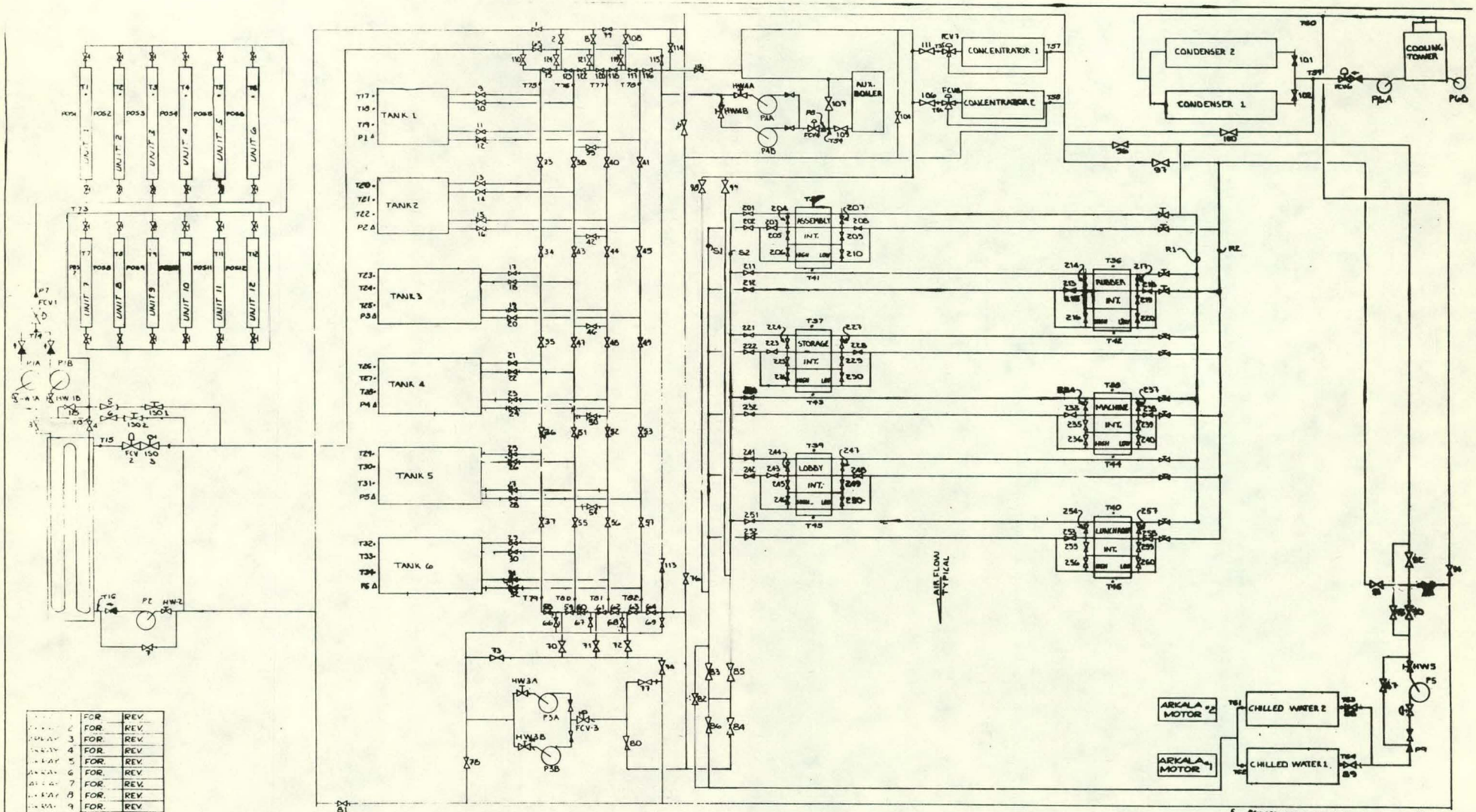
RKL CONTROLS INC.

INPUT/OUTPUT TABLE

DWN BWF 1-6-90

APPD WMM 1-15-90

OU-180 45



	FOR.	REV.
	FOR.	REV.
ARRAY 3	FOR.	REV.
ARRAY 4	FOR.	REV.
ARRAY 5	FOR.	REV.
ARRAY 6	FOR.	REV.
ARRAY 7	FOR.	REV.
ARRAY 8	FOR.	REV.
ARRAY 9	FOR.	REV.
ARRAY 10	FOR.	REV.
ARRAY 11	FOR.	REV.
ARRAY 12	FOR.	REV.

REV		BY	DATE	APP'D
E	REVISED #2,#4,#5,#6A JUNCTION		PM 11-4-80	
D	ADDED COOLING TOWER		PM 6-24-80	
C	REVISED CONNECTIONS TO R2 LINE	BW	6-20-79	
B	REDRAWN PER BILL HUMPHREY REQ.	PLB	10-1-79	
A				

RKL CONTROLS INC.

TITLE: FLOW DIAGRAM SOLAR SYSTEM

SCALE: NONE | DRAWN PAUL H. DATE 9-27-79 | APP'D D.G. DATE 10 31 79

CUSTOMER: SOLAR | DWG NO. DN 10016 | E

SOLAR COLLECTORS

sunworks

SPECIALISTS IN SOLAR ENERGY EQUIPMENT



/sunworks

P.O. BOX 1004 • NEW HAVEN, CONNECTICUT 06508 • (203) 934-6301

RKL Controls, Incorporated
Construction Division
Hainesport Industrial Park
Hainesport, NJ 08036

Bid Proposal & Specification Dates March 1, 1977

1. *Description of Project:*

2. *Collector Area Requested:* 6,604.5 ft^2 (effective)

3. *No. of Collectors:* 357

4. *Dimensions of Collector Panel:*

Type - Flat Plate Water Cooled
Length - 7'0"
Width - 2' - 11 1/2"
Thickness - 4"
Weight of Single Glass Collector - 110 lbs. dry, 114 lbs. wet, or 5.50 lbs./sq.ft.
Weight of Double Glass Collector - 134 lbs. dry, 138 lbs. wet, or 6.63 lbs./sq.ft.
Net Glass Area Per Panel(Aperture) - 18.88 sq.ft.
Net Absorber Area Per Panel - 18.50 sq.ft.
Ratio of Usable Absorber Area to Total Surface Covered - 0.89

5. *Absorber:*

Type of Metal for Absorber Surface - Copper Sheet: 0.01 thick
Surface - Selective Black manufactured by Enthone, Inc.
Absorptivity - Minimum of .87/.92
Emissivity - Maximum of .07/.35
Maximum Allowable Temperature - Over 400°F
Copper Tubes - 1/4" (0.375 O.D.) Type "L" Copper
Tube Spacing - 4" O.C.

Tube Pattern - Grid Vertical to Manifold
Manifold - 1" (1.125 O.D.) Type "M" Copper
Tube Connections to Sheet - Soft Solder
Tube Connections to Manifold - Brazing Alloy
Connection to External Piping - 1" Nominal x 1 3/8" long Nipple Type "M" Copper Extending 0.31 Beyond Collector sides: Supply Lower Right and Left - Return Upper Right and Left
Thermal Isolation - Complete Isolation Between Absorber and Assembly

6. Expansion/Contraction:

Absorber Tube/Sheet has Horizontal Movement Tolerance of Plus or Minus 1/4" at Header Supply and Return Connections.

7. Glass Cover:

Optical Properties of Cover - 92% Solar Transmittance
Thickness - 3/16" Single Glass, 1/8" Double Glass
Type - Tempered, Soda Lime, Water White (with Alum Spacer and Moisture/Ultra Violet Protective Seal & Dessicated in Double Glass Unit)
Edges - Swiped
Air Space Between Double Glass Layers - 1/2"

8. Gasketing Material:

Glass - "U" Shape Neoprene Gasket Continuous at All Sides

9. Insulation Data:

Material - Fiberglass Over Foil Faced Urethane
Thickness - 1" Foil Faced Urethane and 1" Fiberglass
Thermal Properties - R=10
Density - 1.2 lbs./ft.^{3} for Fiberglass

10. Collector Frame:

Sides - Extruded Aluminum : Finish - mill
Bottom - Aluminum Sheet 0.05 Thickness
Glass Lock - Extruded Aluminum: Finish - mill
Connectors - Stainless Steel and Aluminum
Corners - Mitered and Sealed

11. Hydraulic Data:

Material in Contact with Circulating Fluid - Copper
Recommended Flow Rate - 1.75 gph/sq.ft. = .598 GPM/Panel
Absorber Plate or 0.54 gpm per Collector
Flow Resistance - Negligible at Above Rate

12. Methods of Anchoring:

Attachment - Keyway in side of collector along perimeter of frame to accept "U" clips with holes for bolt mounting to roof or frame. Optional 1 1/4: mounting leg integral with top and bottom of frame, 4 holes provide.

Sunworks, specialists in solar energy equipment and systems, is a division of Enthone, Inc., a leading supplier in the plating and metal finishing industry. Enthone is a subsidiary of ASARCO Incorporated, one of the world's largest smelters and refiners of nonferrous metals. Together, they combine their historical leadership in developing quality products for the solar energy industry.

Founded in 1973, Sunworks is one of the first companies in the United States to be exclusively devoted to solar equipment design and production. Through a joint business venture with Enthone, Incorporated, a subsidiary of ASARCO, Sunworks has established modern facilities in Connecticut and New Jersey to provide manufacturing, research, engineering, and technical service for solar equipment. Sunworks is also able to supply experienced, technically oriented personnel to assist you with cost-reducing recommendations for your specific solar project.

Sunworks Products

Sunworks manufactures both liquid cooled and air cooled flat plate solar collectors*, and packaged solar domestic water heaters* suitable for both new and retrofit installations.

The Sunworks flat-plate collector module, called the *Solector*** solar energy collector (Patents Pending), has been developed for solar systems that require high thermal efficiency, long-term performance, and minimum installed cost per BTU delivered. The high efficiency of the *Solector*®solar energy collector is due in part to the exclusive Enthone selective surface on the absorber. This coating assures high absorption of the sun's radiation and low emittance of thermal radiation. The *Solector* solar energy collector can be incorporated with good efficiency into systems that utilize heat up to 240°F. It can be used for domestic water heating, space heating, space cooling, pool heating, laundry drying, crop drying, paper drying, snow melting, low temperature steam production, process heat, and distillation.

The Sunworks packaged solar domestic water heating systems, *Solector* Paks, are available from Sunworks representatives in various system configurations that can be connected to new or existing domestic water heating systems. The basic *Solector* Pak includes two 3′ x 7′ liquid cooled *Solectors* solar energy collectors, storage vessel, circulator, control logic, sensors, fittings and valves unique to the system, installation diagrams and instructions. See your Sunworks representative for system selection and sizing.

*Patents Pending

**Trademark of Enthone, Inc.

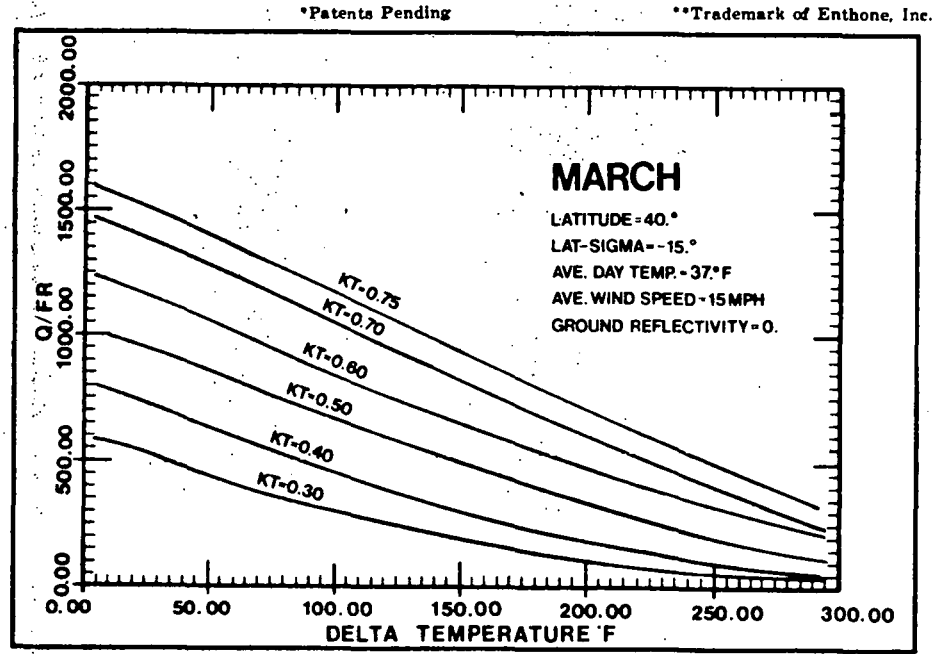


FIGURE 1.

EXAMPLE: To calculate the installed cost per million BTU's per month of a given collector the following procedure may be used. The curves plotted in Figure 1 are based upon the monthly average performance of the Sunwork *Solector*® solar energy collector under conditions of 15 mph wind, during March, at a latitude of 40°N and a tilt of latitude plus 15° (optimum for space heating). For an average temperature rise of 100°F. above the outside ambient, the *Solector* solar energy collector can deliver 720 BTU × $°F_r$ /ft² per day under average cloud cover conditions (k_t = .53) for March. (K_t averaged for lat. 40°). Using an F_r = .90 (forced circulation, single glazed liquid), the collector can deliver 648 BTU/ft² per day × 31 day/month = 20,088 BTU/ft² per month. One million BTU's per month divided by 20,088 = 49.78 ft² of *Solector* solar energy collector required. For a collector cost of $11 per square foot of usable absorber area plus $1 per square foot for installation, the cost per million BTU's in March is $597.37.
(for double glazed liquid *Solector*, F_r = .93)
(for air cooled *Solector*, F_r = .85)

Consulting Services

System Design. Because of the high initial cost of solar heating and cooling systems, equipment must be carefully sized to the requirements of each application based upon solar insolation, environmental conditions, energy requirements and economics.

The size and the calculated performance of the Sunworks packaged domestic water heater can be easily determined by local representatives. A list of Sunworks representatives is available on request from Sunworks or by calling Sweet's Catalog toll-free Buyline Number (800) 255-6880.

Application of solar energy collectors to space heating or air conditioning in buildings normally requires a system designed by a qualified mechanical engineer who is licensed to practice in the locality of the building. Sunworks architectural and engineering staff, through the local Sunworks representative, is available to provide consulting services to qualified architects, engineers, and contractors involved in solar system design.

Computer Analyses. Sunworks has developed computer programs for determining the performance of the *Solector* solar energy collector. Hour-by-hour computer analyses are available to compute performance for different localities and different tilts, orientations and row spacings (See Figure 1.). Sunworks is able to read most N.O.A.A. weather data tapes; customer furnishes tape. A fee is charged for consulting and computer services.

Sunworks Publications

Sunworks publishes and periodically updates several technical booklets covering the design of solar systems for buildings. A basic information pamphlet, Solar Energy Q's and A's, and a complete publication list are available without charge. Please include a stamped, self-addressed envelope. Current Sunworks publications that are available include:

01	Design Criteria for Solar Heated Buildings	$10.00
03	Adapting Design to Climate	$ .75
04	Alternate Energy Sources	$ .75

(Please add $.50 mailing charge. Connecticut residents add 7% sales tax.)

Features of the Solector Solar Energy Collector

1. Availability in Various Models. The *Solector* solar energy collector is available in various models, sizes and finish colors that make it easy to incorporate in contemporary design, traditional styles, and in retrofitting solar heating on existing buildings. *Solector* solar energy collectors are available in two lengths to accommodate various architectural constraints. Both liquid-type and air-type models are compatibly dimensioned and detailed so that they can be used side-by-side on the same building.

If the collectors are to be placed in a corrosive atmosphere, or if other than an aluminum mill finish is desired on the frame, anodized finishes can be specified at additional cost. If breakage of the glass cover is a concern, such as from vandalism, the purchaser can cover the collectors with a layer of ½ in. hardware cloth after they have been installed, or Sunworks will substitute rigid plastic sheets at buyer's cost and risk.

2. High Unit Efficiency. The absorber of the *Solector* solar energy collector is coated with the Enthone® selective surface, an essential ingredient in a high performance collector. The low emissivity of the coating permits use of one cover sheet in areas that would otherwise require two cover sheets over non-selectively blackened absorber plates. The glass cover sheet has extremely high solar transmittance. The annual thermal efficiency of a Sunworks *Solector* solar energy collector with a single-glass-cover is between 25% and 50% higher than a non-selective double-glass-cover collector with a low transmissivity glazing and a flat black absorber. The reasons for this difference are first, the lower reflective losses at higher solar incidence angles with one instead of two glass covers; second, high transmittance glazing (no iron content), further reduces reflective losses at high solar incidence angles over low transmissivity glazings (with iron content); third, the high heat retention properties of the selective surface. The annual thermal efficiency of a single-glass-cover *Solector* solar energy collector is superior to many collectors with two glass covers and a somewhat selective surface at temperature differences between absorber and ambient below 100°F.

Because of this combination of design features, the *Solector* solar energy collector is the most efficient collector available for medium temperature applications at comparable cost. This advantage alone is critically important in integrating solar collectors as part

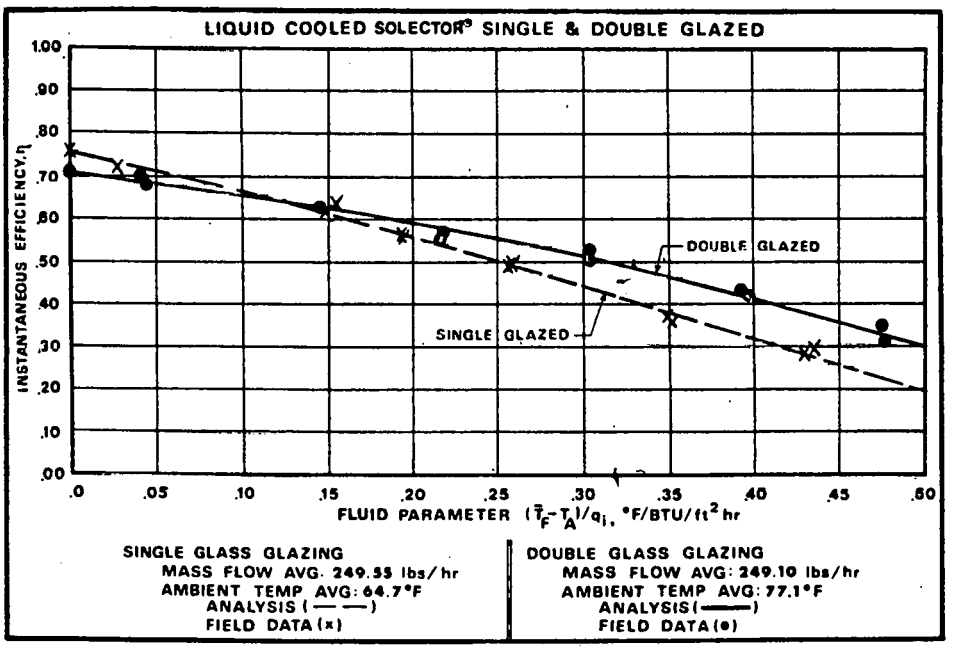
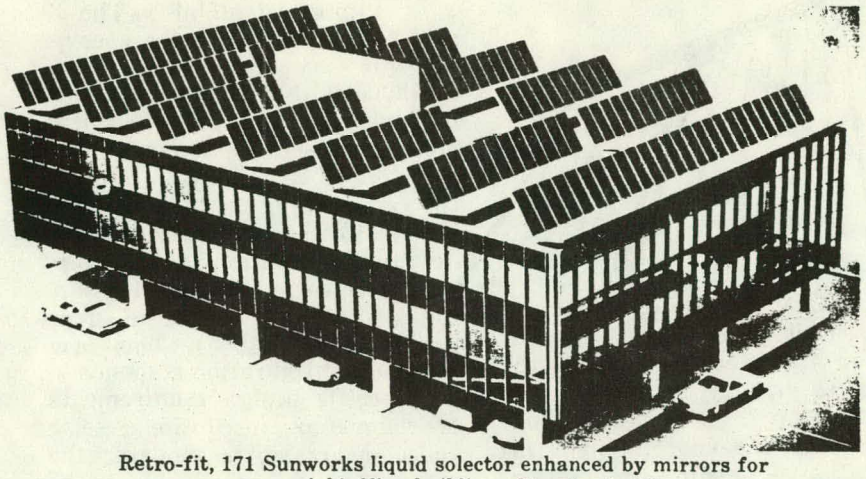


FIGURE 2.

Test conducted by Desert Sunshine Exposure Test, Inc., Phoenix, Ariz. March 1976. (raw data available upon request)

The instantaneous (slope-intercept method) thermal efficiency (η) test is conducted by maintaining constant mass flow and varying the inlet temperature. The parameter used to plot along the abcissa is the average plate temperature minus the ambient temperature divided by the isolation falling on the aperture of the collector. The plot (curve) representing most collectors is not linear as suggested by the basic slope intercept method. Because the heat loss coefficient is temperature dependent, increasing with plate temperature, heat is lost to the ambient from the plate as a function of the difference in the fourth power of the absolute temperature. A higher or 2nd order polynomial is needed to plot a curve to fit the data. This plotting method has been employed in the above curves. The above curves (figure 2) have been generated in accordance to DSET spec. (75-SE2.2). This method generally meets or exceeds the procedure outlined by NBSIR 74-635.



Retro-fit, 171 Sunworks liquid solector enhanced by mirrors for commercial/office building, Stamford, CT.

Developer/Builder	Lutz - Sotire Partnership
Mechanical Engineers	J. O. Hess & Associates
Solar Design	Wormser Scientific Corporation
Project Coordinator	Copper Development Associates

of the building design both in terms of system capability and total installed cost. Less efficient collectors require larger collector areas and larger supporting roofs or structures, with resulting higher installation costs.

A similar procedure such as Figure (1) can be used to compare the cost effectiveness of other collectors. Collector performance figures should be based upon similar conditions such as those assumed in the example. Installation cost estimates should be adjusted to reflect different mounting procedures, piping connections, etc.

Traditionally, collectors have been compared simply on a cost per square foot basis. When there was little difference between available collectors, this was a valid basis for comparison. But now, with the availability of high-performance collectors with long term reliability and durability such as the Sunworks *Solector*® solar energy collector, a different basis for cost comparison should be used. It makes little sense to compare two collectors simply on a cost per square foot basis when collector "A" may deliver 25% more heat per month than collector "B". Further, it makes no sense to buy a low cost collector that has a short life expectancy, when the collector may fail before it can pay for itself in fuel savings. In essence, a buyer/specifier of solar collectors should be looking for equipment that delivers the maximum amount of heat per unit area, per dollar cost and exhibits long term reliability and durability. All objectives should be sought to insure the lowest life-cycle cost.

3. Five Year Guarantee. The most durable materials are used throughout the *Solector* solar energy collector. Under normal conditions, it may be expected to last well over 25 years. Even in no-flow conditions, the collector can withstand temperatures up to 400°F. without material or optical degradation. In the liquid collector, the copper tube to sheet connection is oven soldered over the entire length. All of the materials used in the *Solector* solar energy collector can be specified to meet the requirements of Class A fire zones. The standard *Solector* solar energy collector cover sheet is tempered glass, which is three to four times stronger than annealed glass of the same thickness. It can withstand wind loads up to 140 mph. Edges of the glass are swiped to further reduce the likelihood of breakage.

Factory assembly of the *Solector* solar energy collector assures an integrally joined unit that is soldered and brazed, pressure tested to 250 psi, cleaned, sealed and packaged as a complete module under rigid quality control standards. As a result, the Sunworks collector has one of the most thorough guarantees of any collector available.

The *Solector* solar energy collector carries a 5-year materials and workmanship guarantee (with the exception of cover glass breakage). The copper tubing inside the liquid collector is guaranteed against leaks for 5 years for most uses and transfer fluids. The selective surface is guaranteed to retain a minimum 80%

DAY LONG THERMAL PERFORMANCE

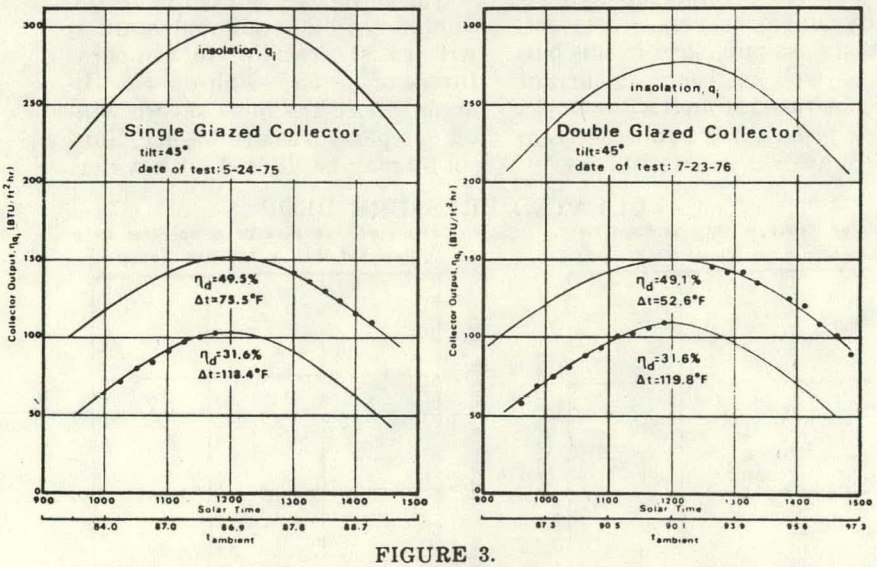


FIGURE 3.

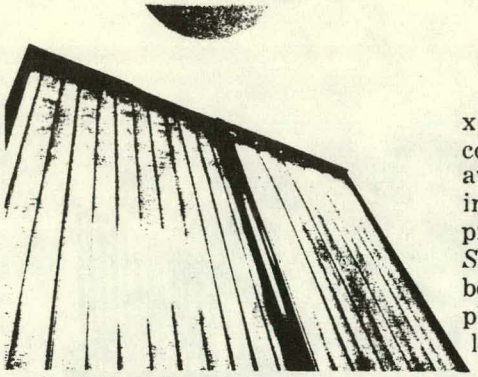
Test conducted by Desert Sunshine Exposure Tests, Inc., Phoenix, Arizona. May/June 1976 (raw data available upon request.) — All day thermal performance is determined by computing the efficiency (η) as a function of time (solar day) while maintaining the mass flow rate and inlet temperature at constant values. The all day efficiency (η) is found by integrating the curve to obtain heat removed by the transfer media from the total isolation received. DEST spec. (75-SE2.4).

or over, of initial optical efficiency for 5 years. A copy of the entire guarantee statement and conditions is available from your Sunworks representative.

4. Easy Installation. Much attention has been given to problems of weather tightness, condensation control, expansion, flashing, durability, and installation ease under actual construction conditions. In addition Sunworks collectors have been under continual field testing for over 3 years. The benefits of this experience have been incorporated into the design of the *Solector* solar energy collector.

The collector is light in weight and can be easily handled by two men. On the liquid cooled *Solector* a continuous mounting flange is integral with the frame across the top and bottom of the collector to facilitate installation. On the air cooled *Solector* preformed "U" clips join the keyways of adjoining *Solectors* as well as providing a tie down point for mounting. The extrusion forming the frame is a structural component which enables the collector to be anchored at both ends without further need to reinforce the unit to resist wind loads. *Solector* solar energy collectors are sized slightly smaller than the maximum dimensions given to eliminate the chance of progressive error in long rows. A keyway on the sides of the frame is provided to permit accurate alignment and interlocking of modules side-by-side where desired. A snap-in flashing reglet around the entire edge of the collector permits easy flashing for any roof or wall condition. Manifolds inside the liquid collector are pitched for rapid draining and elimination of air pockets upon filling. A weeping feature on all models allows the naturally induced condensation to drain from the collector. The absorber plate is free floating on a bed of insulation to allow for thermal expansion and contraction. This free floating absorber and its connections to external piping are thermally isolated from the rest of the collector.

All of these features unique to the *Solector* solar energy collector permit an efficient and reliable installation with low labor cost.



5. Easy Servicing. Little, if any, servicing should be required; but in the event that it is, the glass cover may be removed or replaced on the collector without disturbing the collector unit installation or flashing. In addition, each *Solector* solar energy collector module can be easily removed independent of adjacent modules.

6. Testing. Sunworks has incorporated in all of its product development and technical support comprehensive in-house and independent third-party testing programs. Sunworks has consistently lead the solar industry in promoting and contributing to the development of testing standards as well as publicly providing results of independent thermal performance and reliability/durability testing. In a continuing effort to improve and document the thermal performance and durability/reliability of the Sunworks Solar product line an ongoing testing program has become the foundation of Sunworks' research effort. The test data published in this bulletin as well as the most current data generated from the Sunworks testing program is available from your Sunworks representative.

7. Piping Adaptability. The 3' x 7' liquid *Solector*, solar energy collector (see page 6), is now also available with internal manifolding and side connections. This new piping scheme allows many *Solectors* to be coupled in parallel before returning to the main supply or return branch; resulting in less field connections and less piping accessories while still retaining a high installed net to gross ratio (approx. 88%). This new *Solector* configuration responds to the specific design requirements of commercial/institutional solar collector arrays, maximizing the amount of collectors able to be placed on to the structure while minimizing the installed cost. The optical and thermal properties as well as the physical design features of this new *Solector*, parallels those of the standard liquid cooled *Solector* with the exception of the collector to collector connections.

Sunsol 60

Sunsol 60 is a non-toxic, non-flammable heat transfer media for liquid cooled solar collectors. It contains special corrosion inhibitors that will protect the life of copper and steel components within solar heating systems. Sunsol 60 contains a certified non-toxic dye for easy identification of leaks that may occur in the system.

Sunsol 60 can be used as is, undiluted. In its undiluted state it will resist freezing to temperatures of −55° Fahrenheit. In areas where the most severe winter temperatures are higher, Sunsol 60 may be diluted with water.

CALCULATED PRESSURE DROP

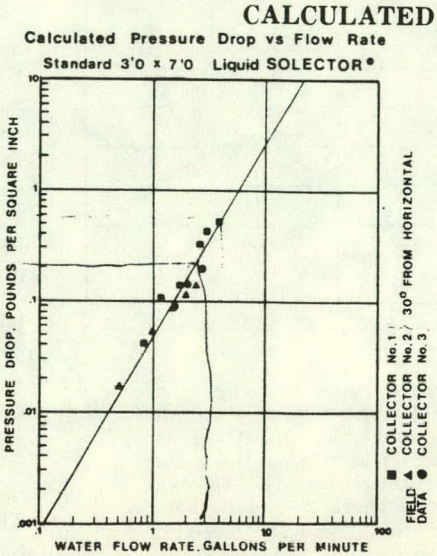


FIGURE 4

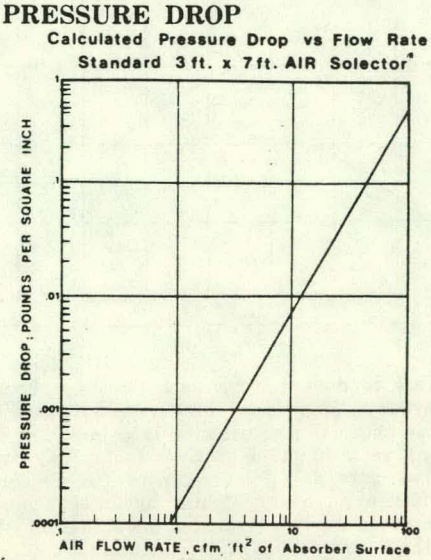
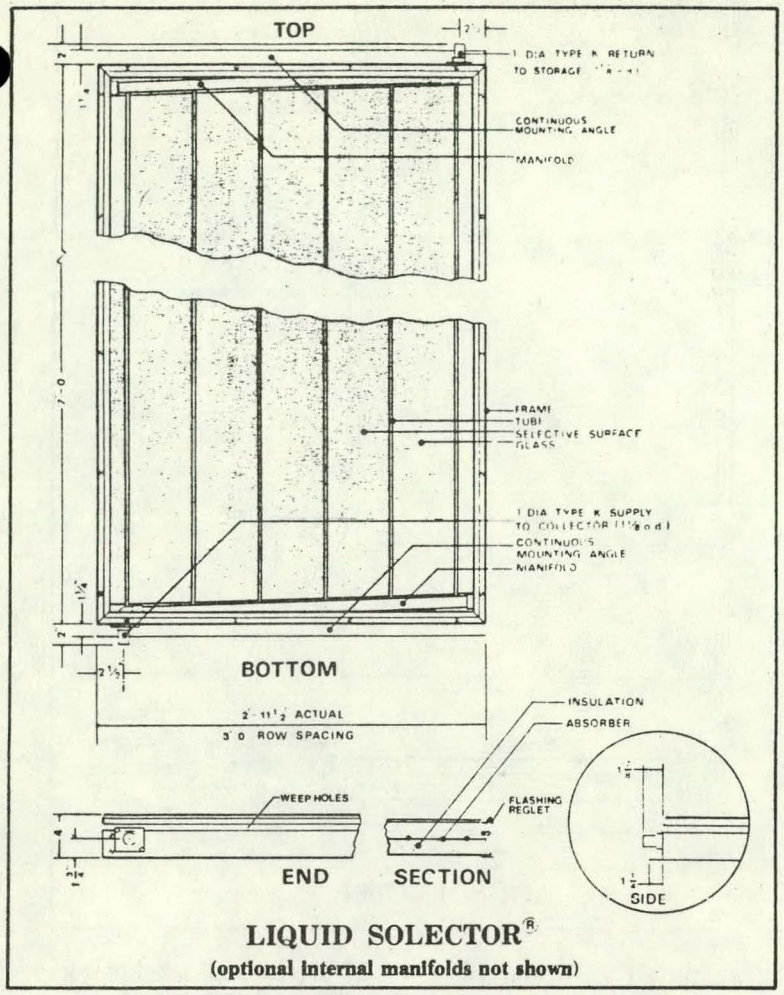


FIGURE 5.



LIQUID SOLECTOR®
(optional internal manifolds not shown)

Technical Data on Solector* Solar Energy Collectors (liquid-cooled and air-cooled)**

Cover: single glazing; no iron content, 3/16 in. tempered, edges swiped; double glazing; no iron content, 2-1/8 in. tempered, edges swiped, sealed unit, total solar transmissivity of, single glazing = 92 % – double glazing = 85%.

Absorber container: sides, aluminum extrusion; rear, aluminum sheet 0.05 in. thickness, pop rivet in place

Air space between cover and absorber: approximately 3/4 to 1 in.

Gasketing material: neoprene "U" gasket

Weatherproofing: this module can be placed out in the weather without need for further weatherproofing

Finish on aluminum sides of container: standard mill finish. Anodized clear or black finish available at extra cost

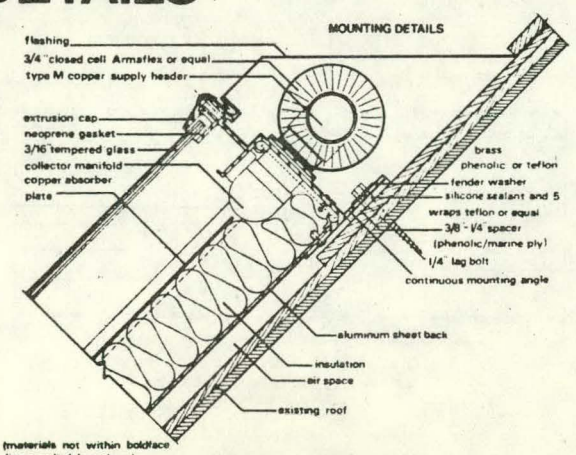
Dimensions of surface-mounted module:
- –outside dimensions overall: 35½ in. wide x 84 in. long x 4 in. thick (add 1¼ in. each end for continuous mounting bracket liquid *Solector* only)
- –effective absorber area = 18.68 ft²
- –ratio of usable absorber area to total surface covered: 0.902
- –glass area: 18.96 ft²

Solector solar energy collectors can be mounted end-to-end for series flow or side-by-side for parallel flow. It is recommended that no more than 3 collectors be connected in series. The *Solector* solar energy collector modules for both liquid and air are identical in size, 3 ft. wide and 4 in. thick and are available in two lengths, 5'4" long or 7'0" long.

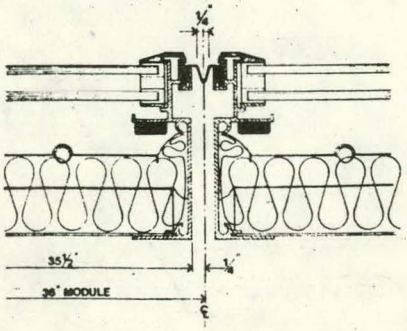
Liquid Data
Solector Solar Energy Collectors

Absorber:
- –copper sheet: 0.010 in. thick (7 oz.)
- –selective black: minimum absorptivity .87/.92 maximum emissivity .07/.35 manufactured by Enthone Inc., guaranteed durable to 400°F.
- –copper tubes: 1/4 in. ID (0.375 in. OD) L-type
- –tube spacing: 6 in. on center
- –tube pattern: grid
- –bond between tube and sheet: high temperature solder
- –manifolds: 1 in. ID (1.125 in. OD) M-type copper
- –tube connections to manifold: brazing alloy
- –connection to external piping: 1 in. ID (1.125 in. OD) K-type copper, extending 1⅞ in. beyond collector ends; supply, top right; return, bottom left (when viewed

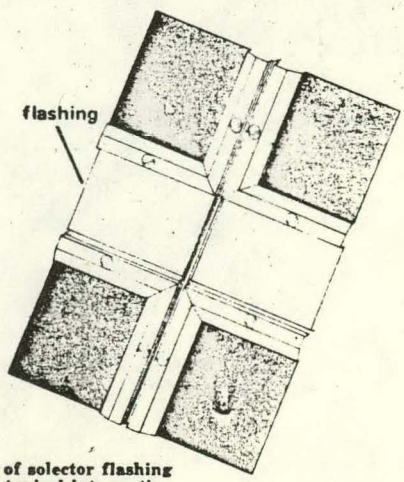
DETAILS



Solector to roof mounting detail (liquid solector).



Solector flashing side to side detail.



Isometric of solector flashing at typical intersection.

from glazing side. See page 5, #7 for internal manifolding *Solector*).
–manifold/tubes pressure-tested to 15 atm; 125 psig working pressure

Insulation behind absorber: 2½ in. thick fiberglass, 1.5 lb/ft³ density, R = 10.0

Method of anchoring: continuous mounting bracket at each end of frame for anchoring; four predrilled holes are provided for anchor bolt or screw connections; additional holes may be drilled by installer if required.

Weight per module: 113.9 pounds, filled; 111 pounds, empty. Add 27 lbs. for double glazed unit. (NOTE: the liquid in the collector is equal to: 0.36 gallons or 46.4 ounces or 2.90 pounds or 0.05 ft³ or 80.5 in³.)

Recommended flow rate through collector: 14.7#/ft²/hr (.55gpm) per collector (single glazed F_r = .90, double glazed F_r = .93) (flow resistance at this rate is negligible. See figure 4).

Collector coolant: coolant should be Sunsol 60 made by Sunworks. In areas where regular tap water is used as a coolant, it is important that the pH be controlled between 6.5 and 8. These collectors can be used with other coolants but the user must contact the manufacturer for approval of specific liquids. (See guarantee statement available from Sunworks representatives.)

Air Data
Solector Solar Energy Collectors

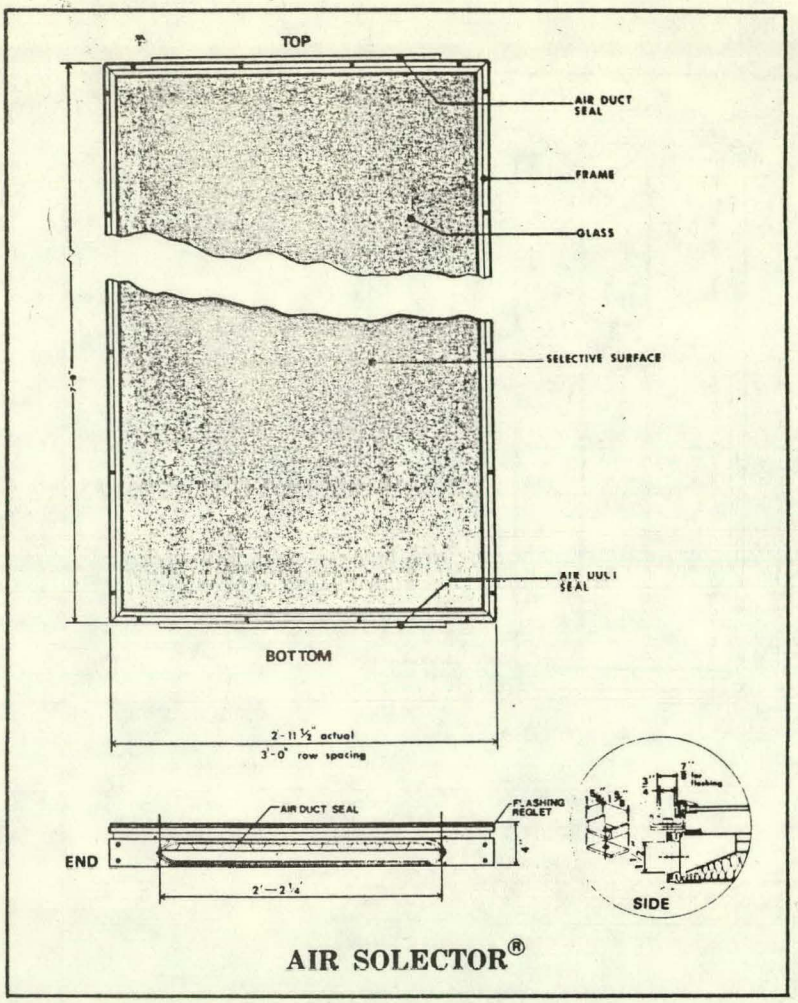
Absorber:
–copper sheet: 0.016 in. thick (12 oz.)
–selective black: minimum absorptivity .87/.92 maximum emissivity .07/.35 manufactured by Enthone, Inc. durable to 400°F.
–air chamber: ⅞ in. high, thermal conductive epoxy bond to absorber
–connection to external duct: pressure seal/neoprene gasket
–distribution pattern: parallel top to bottom, under absorber

Insulation behind absorber: 1 in. thick fiberglass plus 1 in. urethane: R = 10 Method of anchoring: prefabricated 'U' clip in key way at top and bottom of *Solector* bolt through 'U' clip to supporting structure.

Weight per module: 116 lbs. Add 27 lbs. for double glazing

Recommended flow rate through collector: 3cfm/ft² of collector (flow resistance at this rate is negligible. See figure 5).

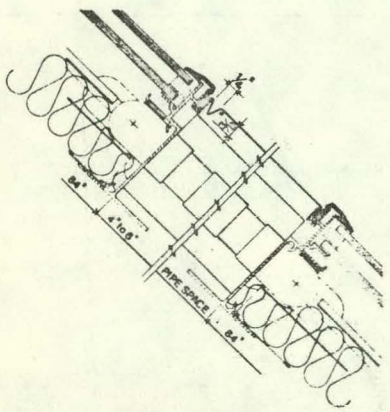
NOTE: Manufacturer reserves right to change specifications and dimensions without notice.



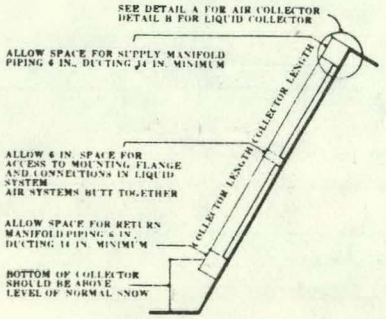
AIR SOLECTOR®

*Trademark of Enthone, Inc.

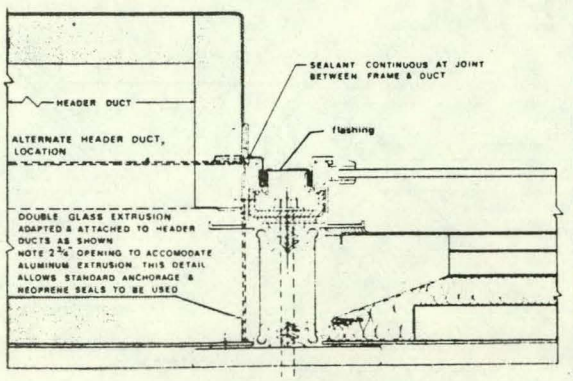
**Patents Pending



Solector flashing top to bottom detail.



Solector spacing in series.



Solector to roof/duct mounting detail (air solector).

Your Sunworks Representative:

Technical Publication 02

sunworks

SPECIALISTS IN SOLAR ENERGY EQUIPMENT

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PERFORMANCE SPECIFICATIONS

The complete technical data for the Sunworks *Solector** solar energy collectors are listed on pages 6 & 7. The collector also meets or exceeds the following performance specifications. Specifications unique to liquid flate-plate collectors are underlined. The specifications unique to the air flat-plate collectors are in [brackets.]

General — The collector shall be designed to absorb incoming solar radiation and transfer the resulting heat to a circulating fluid. The collector shall consist of _____ cover sheet(s), absorber plate coated with a selective surface, insulation and enclosure assembled in a manner to maintain thermal and mechanical performance over a minimum 25 year service life. The collector shall be guaranteed against leaks and against degradation of the selective surface for 5 years.

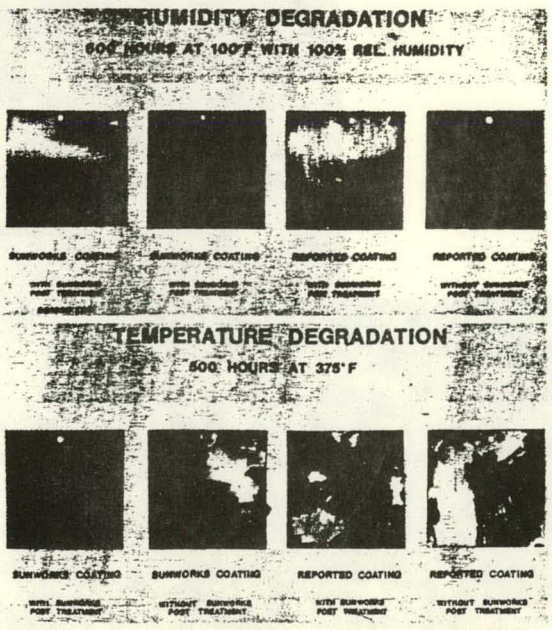
Thermal Performance — The instantaneous efficiencies of the collector shall be certified to be equal or better than those lying on a curve defined by the following six points (with Q_{inc} = 300BTU/HR/ft²; all degrees measured in Fahrenheit):

	GLAZING	
	SINGLE	DOUBLE
$\Delta T = 20°$, $\Delta T/Q_{inc} = 0.07$	Efficiency = 69%	68%
$\Delta T = 50°$, $\Delta T/Q_{inc} = 0.17$	Efficiency = 58%	61%
$\Delta T = 100°$, $\Delta T/Q_{inc} = 0.33$	Efficiency = 40%	49%
$\Delta T = 150°$, $\Delta T/Q_{inc} = 0.50$	Efficiency = 20%	31%
$\Delta T = 200°$, $\Delta T/Q_{inc} = 0.67$	Efficiency = —	11%

$$\Delta T = \frac{Tin + Tout}{2} - Tamb$$

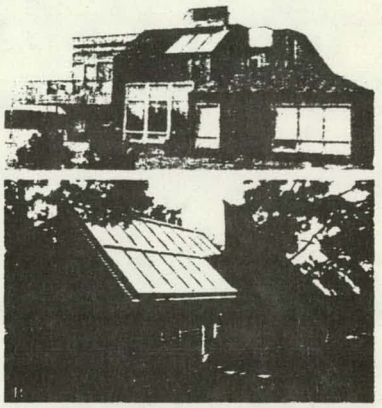
Mechanical Performance — The collector unit must withstand conditions of extended radiation, humidity, condsensation, temperatures under no-flow conditions up to 400°F., wind loads up to 140 mph, rain and snow. The collector unit must withstand expansion and contraction of the enclosure and of the connecting supply and return lines outside the collector. Penetrations of the extrusion for supply and return lines shall be gasketed so as to prevent air infiltration to the collector enclosure. All the materials used in the collector shall meet the requirements of Class _____ fire zones. Where multiple cover sheets are used, the spaces between covers shall be rigidly separated and sealed with U.V. protection. The absorber plate shall have a heat removal efficiency of .90 at .55 gpm per collector, using water as the heat transport fluid. Provision must be made for venting and draining of flow passages. The absorber shall have a grid flow pattern. The absorber sheet shall be continuously soldered to the tubing. The absorber shall be self-draining, and on filling, self venting. The tubing within the assembled collector shall be pressure tested by the manufacturer up to 250 lbs. psi. and shall have a working pressure in excess of 125 psi.

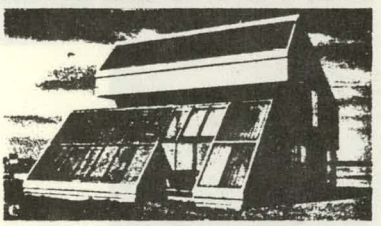
[The heat transfer core behind the absorber shall have a heat removal efficiency of 0.85 at 60 cfm per collector, using air as the heat transfer fluid. The heat transfer core shall be in intimate thermal contact with the absorber. The core shall be capable of withstanding an air pressure equal to one inch of water pressure without rupture.] The back insulation shall have an approximate "U" value equal to 0.11 BTU/HR/ft²F. The enclosure shall protect the assembly in normal shipment, installation, and service conditions. Penetration of supply and return tubing [ducting] through the collector shall be weathertight. The cover sheet(s) shall be attached in a manner that permits servicing of an individual collector module by removing the cover sheet without removing the flashing or the entire module and without disassembling the entire module and without disassembling the entire array. Provision should be made for easily attaching flashing to the collector.

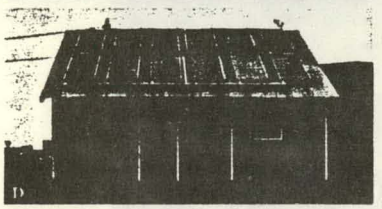


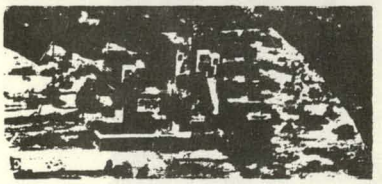
SELECTIVE SURFACE

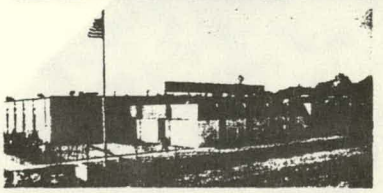
The Sunworks selective surface, developed by Enthone, Inc., is a non electrolytic conversion process yielding a thin film oxide. Enthone has developed a proprietary process in which the depth of oxidation is precisely controlled, resulting in a high solar absorbtivity .87/.92 and a low thermal emissivity .07/.35. Sunworks division, Enthone, Inc. has further developed this process to assure the reliability and durability of this coating over extended periods of time under extreme environmental conditions. This selective coating and coating process is only available from Sunworks division, Enthone, Inc.











A. [illegible] — 75% solar hot water needs for family of three, Long Island, N.Y.

B. [illegible] — drain down system, — C. Granbery F.A.I.A. Architect, CT.

C. [illegible] — 26 air solectors for space heating, 4 liquid solectors for hot water. Long Island, N.Y. Residence.

D. [illegible] — Army Corps of Engineers Experimental House Research Laboratory, Champaign, Ill.

E. [illegible] — Builder Dick Blazej, Grassy Brook Village, Vt.

F. SUNWORKS MANUFACTURING — 30,000 square ft. plant, Somerville, N.J.

*Trademark of Enthone, Inc.

Printed in U.S.A.

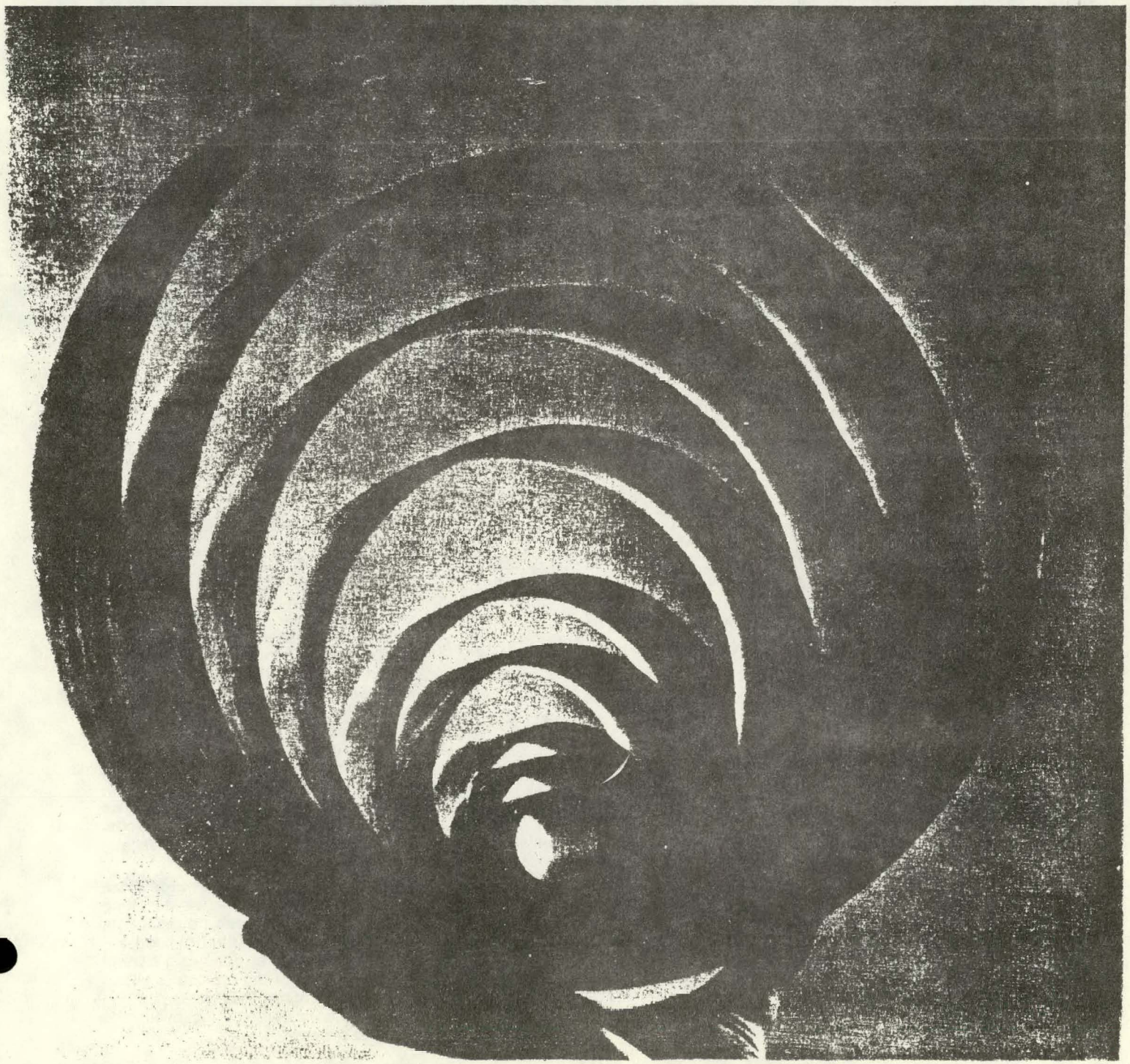
DIVISION OF ENTHONE INCORPORATED WEST HAVEN, CONNECTICUT

A subsidiary of ASARCO

SOLAR PIPING

for use in
chemical processing
food processing
industrial applications
heating & air conditioning
petroleum production
& marketing
gas distribution
pollution control

glass fiber reinforced piping systems



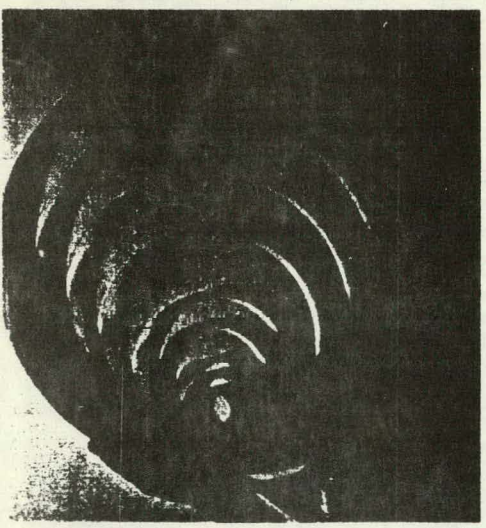
your best choice is a glass fiber reinforced pipe system

lower installation cost

Every A.O.Smith-Inland piping system offers the tremendous advantage of *lighter weight.* Compared to most materials you may consider, this translates into easier and faster installation. In these days of ever-increasing labor prices, the savings in material handling and installation time offered by glass fiber reinforced pipe (FRP) must be considered a vital part of your piping system cost. As part of this, it is imperative that a complete selection of fittings be available for the pipe you choose. A.O.Smith-Inland has fittings for every type and size pipe.

longer service life

The high corrosion resistance of reinforced plastic pipe makes it a logical choice over protected steels, black iron, copper and even stainless steel. Many years of experience have proven that the service life of glass fiber reinforced resin pipe will be greater than the traditional material. Select the right pipe for your application requirements and enjoy the resulting reduction in maintenance and replacement costs.



light weight and full range of sizes

One of the primary advantages of A.O.Smith-Inland glass fiber reinforced pipe systems is their light weight in comparison to metal pipe. This light weight is of great value in reducing manpower and heavy equipment required in pipe installations, particularly in the larger diameters. A.O.Smith-Inland pipe systems are available in a full range of sizes ranging from 1″ through 16″ diameters as standard product lines, depending upon the pipe system chosen.

choice of systems

A.O.Smith-Inland offers a wide range of superior piping systems (pipe and fittings) to match your requirements in both price and chemical resistance.

Choose from this outstanding family of filament wound glass fiber reinforced pipe.

RED THREAD® A glass fiber reinforced epoxy resin pipe with the proven ability to solve corrosion problems in moderate chemical service at temperatures up to 210 F. RED THREAD pipe is available and stocked in diameters 2″ thru 12″.

RED THREAD has been in oilfield service since 1955 . . . has continuously proved its ability to withstand punishing operating conditions.

SILVER THREAD™ An epoxy resin pipe for moderate chemical service to 210 F. Available in 2″ thru 12″.

The newest addition to the line has a reinforced resin impregnated with a reactive material that provides effective screening from damaging ultraviolet rays. This is the first pipe of its kind.

This material is especially good in outdoor installations and [illegible] above the RED THREAD line.

GREEN THREAD An epoxy resin pipe [illegible] chemical resistance [illegible] temperatures to 225°F. GREEN THREAD is available in 1″ thru 12″.

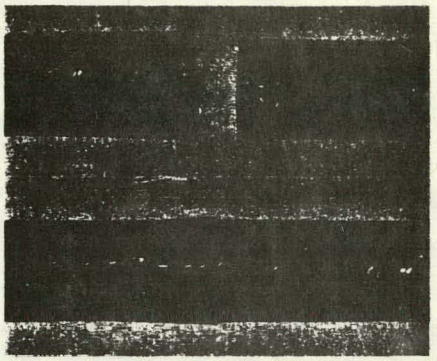
[illegible] glass reinforcing [illegible] wall strength [illegible] resistant glass [illegible] resin liner. [illegible] a wider [illegible] conditions than RED or SILVER [illegible]

[illegible] reinforced epoxy [illegible] for service [illegible] applications, incorporating [illegible] liner composed of [illegible] resin and reinforcement [illegible] resistance to chemical [illegible] and impact.

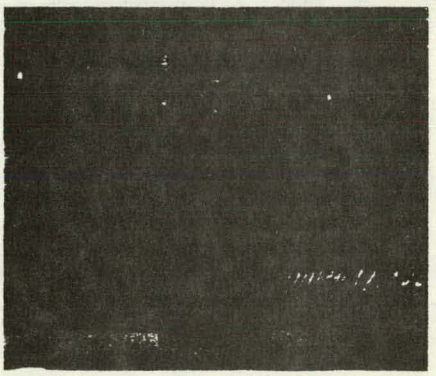
[illegible]-LINE is specified for corrosion resistance [illegible] temperatures to 225°F.

[illegible] reinforced [illegible] is designed for [illegible] operating pressures up to [illegible] and is usually adopted to [illegible] systems [illegible]

[illegible] acids, chlorines [illegible] provided by the interior [illegible] This pipe is available [illegible]



BELL AND SPIGOT



REDI-THRED®

choice of joining methods

A.O.Smith-Inland offers a choice of proven joining methods. Each has distinct advantages in a given application and you can select the method most suitable to your installation requirements.

Bell and Spigot This is the primary method used for joining A.O.Smith-Inland systems and is the result of extensive research and development. This joint has been proven by years of field installation in all types of service. In this system, the pipe is supplied with one end tapered and the other end belled to accept a taper. The joint is secured with an adhesive designed to complement the operating conditions of the pipe system employed. The fittings are also manufactured to accept the tapered end of the pipe. The taper can be readily applied to the pipe in the field with a tool specifically made for the purpose.

The precise taper system insures those requirements necessary for a strong joint . . . uniform adhesive distribution, thin bond line and natural locking action. The latter is of additional benefit in installation, as the locking effect of the taper maintains the joint in position while the adhesive cures, allowing the work to proceed.

from A.O. Smith-Inland Inc.

REDI-THRED® The REDI-THRED joint system is designed for rapid assembly of long runs of pipe. Each 30′ length of 2″, 3″ or 4″ RED THREAD is supplied with the REDI-THRED coupling factory installed.

The REDI-THRED couplings require no adhesive. Joints are completed in seconds without turning the entire pipe . . . just the threaded collar. Ideal for wet or cold weather use, and for temporary or permanent lines.

Threaded High-Pressure A.O. Smith-Inland also manufactures high pressure systems which are joined with an EUE 8-round thread. This method provides rapid installation and positive make-up for long-term performance. This system is primarily designed for oilfield applications but is suitable wherever pressure requirements of up to 2000 psi exist.

A.O. Smith-Inland pipe and fittings serve a wide variety of applications

RED THREAD pipe and fittings are used extensively in petroleum production, in light duty chemical and industrial applications, in water and air lines, food processing plants . . . wherever light weight and moderate corrosion resistance are important factors.

SILVER THREAD, the newest A.O. Smith-Inland piping system, offers the same good resistance as RED THREAD in light duty chemical service, hard brines, air lines, etc. The ability to handle higher temperatures makes SILVER THREAD ideal for chill and hot water lines in commercial heating and air conditioning.

GREEN THREAD has good chemical resistance to the more aggressive chemicals at temperatures up to 225°F. It is used in process piping, condensate return lines, filtering systems, dilute acid lines and other similar applications.

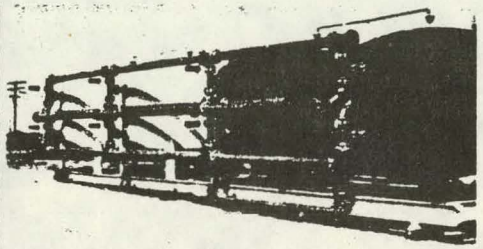
POLY THREAD combines the best features of epoxy and polyester resins in a vinyl ester and glass fiber combination for unusual strength, flexibility, and resistance to acid, chlorine and bleach. Bell and spigot joining, plus a complete line of flanged bell end fittings, make POLY THREAD a highly versatile piping system.

A.O. Smith-Inland piping systems are finding ever-increasing varieties of applications because of their light weight, strength, corrosion resistance, and cost. Our customers include:

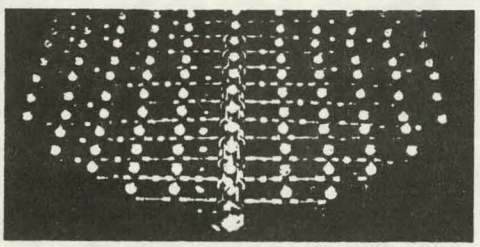
- Pulp and Paper Plants
- Chemical Processing Industries
- Food and Beverage Manufacturers
- Mining Industries
- Oilfields
- Refineries
- Steel Mills
- Fertilizer Manufacturers
- Industrial Plants
- Power Plants
- Chlorine-Caustic Plants
- Commercial Air Conditioning
- Municipal Aquariums
- Gasoline Service Stations
- Gas Distribution Companies



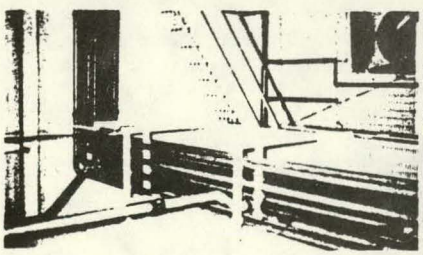
Twelve 3″ RED THREAD flow lines in a typical oilfield installation. Lines are tied directly into header.



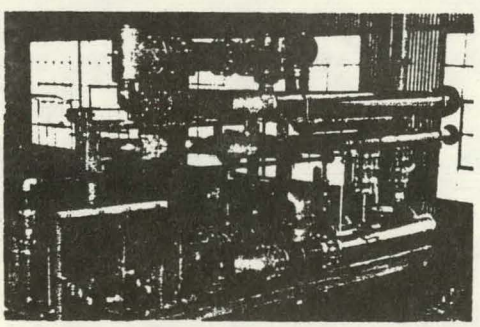
GREEN THREAD pipe and fittings on a custom-made filter for chemical processing.



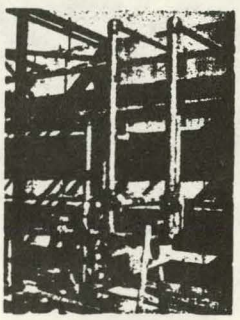
GREEN THREAD was exclusively used in this complex internal filter grid for the same filter system. The solution being handled is a dilute sulfuric acid.



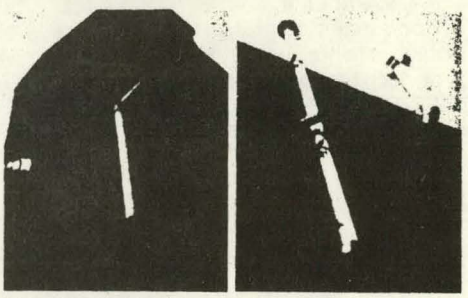
A RED THREAD installation in a chemical plant handling latex. The smooth, glossy interior surfaces resist build-up and do not contaminate the latex with metallic ions, a problem in the metallic lines previously used.



Unique self-contained water purification unit extensively utilizes A.O. Smith-Inland glass fiber reinforced epoxy pipe and fittings. Preassembled piping network and controls eliminate high field erection costs. Units are frequently used in low temperature and corrosive atmospheres.



Extensive GREEN THREAD application in a copper mining installation. GREEN THREAD pipe and fittings in this installation handle a 2% to 5% sulfuric acid solution at 180° to 200°F temperatures. This installation illustrates the suitability of reinforced plastics in complex piping assemblies.

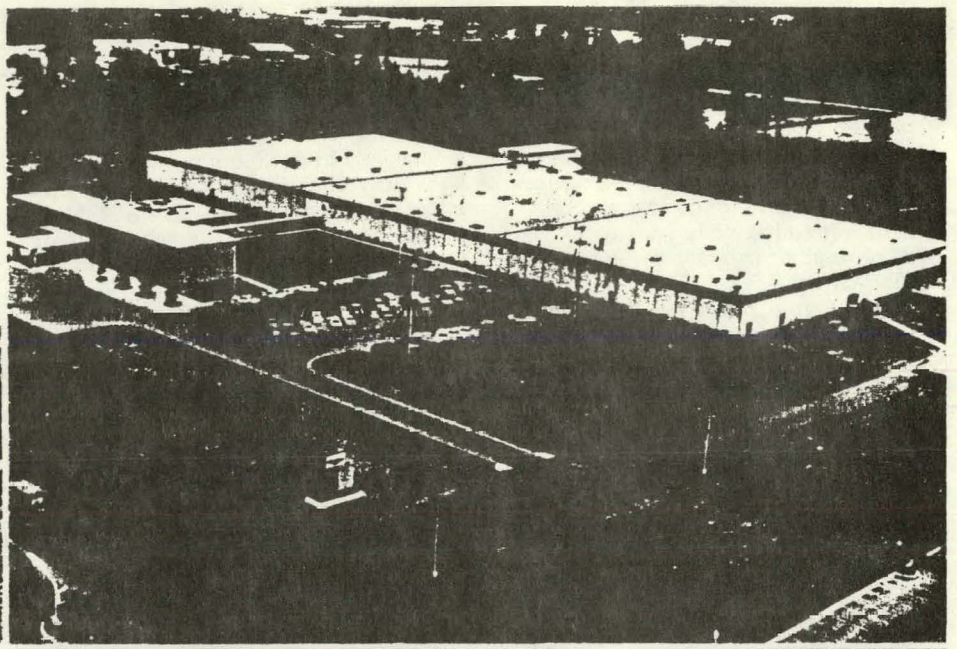


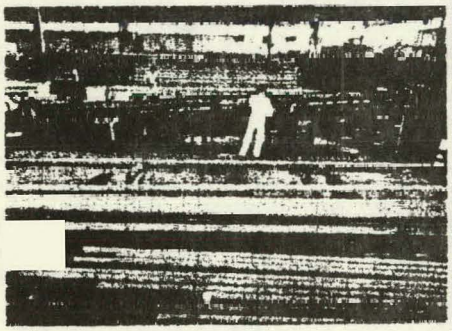
This POLY THREAD installation in a steel mill provides acid waste unloading lines from pickling tanks. Lines handle hydrochloric, sulfuric and 5% chromic acids at continuous 180°F, with surges to 200° F.

modern research and production facilities

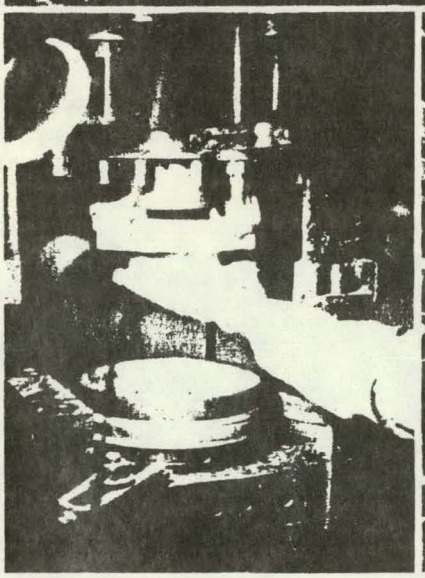
Ultra modern plant of 193,000 sq. ft. is devoted exclusively to the manufacture of glass fiber reinforced epoxy and vinyl ester pipe and fittings.

This building complex located in Little Rock, Arkansas, includes our home administration and sales office —plus our own expertly staffed research and development center.





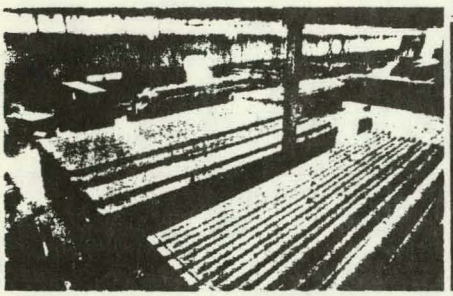
Extensive testing conducted on all pipe production runs assures uniform high quality field operation. This is a hydrostatic mill pressure test in the A.O.Smith-Inland plant, and is just one of the many quality control tests utilized to insure that the products reach the high standards that have been established.



Uniform, accurate fittings are produced on specially designed molding presses. You can select a complete piping system with assurance of the easiest and fastest installation at the most economical cost — using the same material throughout.



Fittings of all types, in every shape and size are available for each type of A.O.Smith-Inland pipe. This is a portion of the huge fittings inventory at Little Rock. All fittings offer the same reliability as the pipe — for pressure, temperature, and chemical resistance.



Large finished stocks of all types and sizes of pipe are maintained on the spacious floor area of the Little Rock manufacturing facility. All are available through a wide network of A.O.Smith-Inland distributors.

DISTRIBUTED BY

A.O. Smith INLAND

A.O. SMITH-INLAND INC.

REINFORCED PLASTICS DIVISION

2700 WEST 65th STREET • LITTLE ROCK, ARKANSAS 72209

A. O. SMITH-INLAND INC.
REINFORCED PLASTICS DIVISION

2700 W. 65TH STREET / LITTLE ROCK, ARKANSAS 72209
AREA CODE 501 568-4010

Price Schedule
Aug. 15, 1976

RED THREAD,® SILVER THREAD,® GREEN THREAD,® and POLY THREAD® FITTINGS

This price list covers the fittings for use with RED THREAD®, SILVER THREAD®, GREEN THREAD®, and POLY THREAD® piping.

Because of standarization, SILVER THREAD fittings can be used with either RED THREAD or SILVER THREAD and most 2" through 6" SILVER THREAD fittings are suitable for use with new dimension GREEN THREAD pipe. All fittings marked with a (†) will be SILVER THREAD instead of GREEN THREAD. Do not use any other SILVER THREAD fittings on GREEN THREAD pipe.

The GREEN THREAD fittings which are available can be used only with GREEN THREAD pipe and POLY THREAD fittings can be used only with POLY THREAD pipe. Only a limited number of RED THREAD fittings are available and are specified where applicable.

1" and 1 1/2" fittings are available in GREEN THREAD only; 14" and 16" fittings are available in POLY THREAD only.

90° and 45° ELBOWS – Bell or Flanged Ends(1)
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	BxB	BxF	FxF
1"	$ 10.00	$ 20.00	$ 26.00
1½"	11.00	24.00	32.00
2"	12.25†	27.60†	39.60†
3"	16.25†	34.20†	48.50†
4"	20.10†	45.00†	60.00†
6"	55.00†	92.00†	100.00†
8"	98.00	125.00	150.00
10"	115.00	150.00	190.00
12"	132.00	180.00	235.00
14"	200.00	300.00	400.00
16"	230.00	340.00	450.00

TEES – Bell or Flanged Ends(1)
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	3B	2B-1F	1B-2F	3F
1"	$ 11.00	$ 22.00	$ 27.00	$ 32.00
1½"	14.00	25.00	33.00	42.00
2"	17.60†	29.75†	43.45†	53.35†
3"	19.00†	39.00†	54.75†	67.35†
4"	25.00†	50.25†	72.50†	82.75†
6"	72.00†	104.00†	116.00†	127.00†
8"	120.00	155.00	175.00	190.00
10"	170.00	200.00	240.00	275.00
12"	210.00	250.00	285.00	330.00
14"	275.00	400.00	575.00	675.00
16"	325.00	475.00	625.00	785.00

FLANGES and BLIND FLANGES
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	Flanges	Blind Flanges
1"	$ 5.80	$ 9.25
1½"	6.20	9.50
2"	6.80†	9.00†
3"	9.00†	12.25†
4"	12.75†	14.50†
6"	25.25†	27.00†
8"	39.00	41.00
10"	48.00	69.00
12"	60.00	90.00
14"	120.00	180.00
16"	145.00	216.00

SLEEVE COUPLINGS, THREADED ADAPTERS and GROOVED ADAPTERS(2)
RED THREAD – SILVER THREAD – GREEN THREAD – POLY THREAD

Size	Sleeve Couplings	*Grooved and Threaded Adapters
1"	$ 2.95	$ 4.50
1½"	3.15	5.00
2"	3.50	5.10
3"	5.10	6.85
4"	7.10	10.55
6"	17.00	23.10
8"	28.00	32.00
10"	42.40	-
12"	57.00	-
14"	59.00	-
16"	65.00	-

**These fittings are not available in POLY THREAD.*

NIPPLES – Tapered Both Ends
RED THREAD – SILVER THREAD

Size	Overall Length 4"	6"	8"	10"	12"	24"	36"
2"	$1.23	$1.58	$1.94	$2.23	$ 2.56		
3"		2.13(3)	2.61	3.04	3.80		
4"		2.54	3.26	3.84	4.40		
6"		3.42(3)	4.45	5.61	6.84		
8"					13.00	$24.00	
10"						41.00	$55.00
12"						54.00	68.00

NIPPLES – Tapered Both Ends
GREEN THREAD – POLY THREAD

Size	Overall Length 6"	8"	12"	16"
1"	$2.10	$2.60		
1½"	2.25	2.75		
2"	2.40	2.90		
3"	3.10	3.75		
4"	3.80(4)	4.40		
6"	4.90(3)	7.50	$12.50	$16.00
8"			17.00	19.15
10"			25.00	28.00
12"			40.00	49.00
14"			55.00	62.50
16"			70.00	80.00

® Registered Trademark of A. O. Smith-Inland Inc.

(1) B-bell end; F-flanged end.

(2) Grooved adapters available in spigot x groove or bell x groove. Threaded adapters available in bell x male NPT, bell x female NPT, spigot x male NPT, and spigot x female NPT.

(3) Actual length is 6¼".

(4) Actual length of Poly Thread nipple is 6 3/8.

A. O. SMITH-INLAND INC.
REINFORCED PLASTICS DIVISION

Price Schedule
Aug. 15, 1976

2700 W. 65TH STREET / LITTLE ROCK, ARKANSAS 72209
AREA CODE 501 568-4010

RED THREAD,® SILVER THREAD,® GREEN THREAD,® and POLY THREAD® FITTINGS

45° LATERALS
Bell or Flanged Ends(1)
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	3B	3F
1"	$ 23.00	$ 42.00
1½"	24.50	46.00
2"	30.00	62.50†
3"	40.00	80.00†
4"	50.00	100.00†
6"	112.00	160.00†
8"	150.00	235.00
10"	180.00	400.00
12"	220.00	500.00
14"	380.00	800.00
16"	450.00	900.00

CROSSES
Bell or Flanged Ends(1)
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	4B	4F
1"	$ 23.00	$ 50.00
1½"	26.00	62.50
2"	30.00†	75.00†
3"	36.00†	92.50†
4"	42.00†	118.50†
6"	140.00†	185.00†
8"	190.00	270.00
10"	250.00	450.00
12"	310.00	560.00
14"	500.00	1000.00
16"	600.00	1200.00

CONCENTRIC REDUCERS – Bell or Flanged Ends(1) and REDUCER BUSHINGS
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	Concentric Reducers BxB	Concentric Reducers FxF	Reducer(3) Bushings
1"x½"	$ -	$ -	$ 5.00
1½"x1"	-	-	5.00
2"x1½"	29.35	40.00	6.50†
3"x2"	34.20†	49.45†	6.25†
4"x3"	41.00†	59.15†	7.40†
6"x4"	57.75†	79.00†	12.15†
8"x6"	73.00	103.00†	22.75
10"x8"	105.00	145.00†	55.00
12"x10"	140.00	190.00†	70.00
14"x12"	155.00	280.00	75.00
16"x14"	170.00	350.00	78.00

REDUCING SADDLES – Belled Side Outlet(4)
SILVER THREAD – GREEN THREAD – POLY THREAD

	Side Outlet Size									
Size	1"	1½"	2"	3"	4"	6"	8"	10"	12"	14"
2"	$12.00†	$12.00†								
3"	12.00†	12.00†	$16.00†							
4"	12.00†	12.00†	16.00†	$22.00†						
6"	13.00†	13.00†	17.00†	23.00†	+23.00†					
8"	13.00	13.00	17.00	23.00	23.00	$45.00				
10"	13.00	13.00	17.00	23.00	32.00	45.00	$ 90.00			
12"	13.00	13.00	23.00	23.00	32.00	45.00	90.00	$110.00		
14"			27.00	30.00	36.00	55.00	100.00	130.00	$150.00	
16"			27.00	30.00	36.00	55.00	100.00	130.00	150.00	$160.00

END CAPS(5)
SILVER THREAD – GREEN THREAD – POLY THREAD

Size	B
2"	$6.15†

STIFFENERS and REDI-THRED® COUPLINGS
RED THREAD Only

Size	Coupling	Stiffener
2"	$14.25	$2.50
3"	18.00	4.25
4"	24.00	5.25
6"	-	6.75

REDI-HEAT® PACK

Size	
2"	$ .85
3"	.95
4"	1.05
6"	1.35

ADHESIVE KITS(6)

DS-7014 (25 min. pot life)	6.8 oz.	$ 6.00
DS-7024 (25 min. pot life)	2.50 oz. twin pack	8.25
DS-7054 (25 min. pot life)	1.6 oz. small pack	2.50
DS-7069 (25 min. pot life)	9.95 oz.	7.75
DS-7125 (20 min. pot life)	6.8 oz.	6.25
DS-8014 (15 min. pot life)	6.35 oz.	6.25
DS-8024 (15 min. pot life)	2.66 oz. twin pack	8.25
DS-8055 (15 min. pot life)	1.3 oz. small pack	2.50
DS-8069 (15 min. pot life)	9.22 oz.	8.00
DS-9014 (20 min. pot life)	6.34 oz.	6.50
DS-9024 (20 min. pot life)	3.1 oz. twin pack	8.50
DS-9069 (20 min. pot life)	14.44 oz.	8.00
DS-8088 (Maintenance and Repair Kit)		13.50

MINIMUM ORDER – Total quantity $50.00.

TERMS – F.O.B. origin. Prices subject to change without notice. Subject to conditions of sale as printed on reverse side of pipe price schedules.

(1) B-bell end; F-flanged end. (3) 2"x1", 2"x1½" reducer bushings with NPT female threads available. (4) 2", 3", 4" & 6" saddles are available with 1", 1¼" or 1½" NPT threaded side outlets. (5) End caps in other sizes available on special quotation. (6) Consult Bulletin A100-1 to determine proper adhesive usage.

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TABLE I.I

ULTIMATE AND ALLOWABLE DESIGN STRESSES AND OTHER PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	RED THREAD 75°F	RED THREAD 150°F	SILVER THREAD 75°F	SILVER THREAD 210°F	GREEN THREAD 75°F	GREEN THREAD 225°F
Axial Tensile							
Ultimate Stress	ASTM D2105	9,100 psi	8,320 psi	10,300 psi	6,100 psi	9,740 psi	5,110 psi
Design Stress		2,275 psi	2,080 psi	2,575 psi	1,525 psi	2,435 psi	1,280 psi
Modulus of Elasticity	ASTM D2105	1.15×10^6 psi	1.0×10^6 psi	1.4×10^6 psi	0.89×10^6 psi	1.07×10^6 psi	0.57×10^6 psi
Axial Compression							
Ultimate Stress	ASTM D695	13,500 psi	11,800 psi	17,800 psi	11,300 psi	30,300 psi	17,200 psi
Design Stress		3,375 psi	2,950 psi	4,450 psi	2,825 psi	7,575 psi	4,300 psi
Modulus of Elasticity		1.01×10^6 psi	0.67×10^6 psi	0.85×10^6 psi	0.83×10^6 psi	1.49×10^6 psi	1.25×10^6 psi
Beam Bending							
Ultimate Stress	AOS-I TM	18,300 psi	11,900 psi	17,800 psi	8,500 psi	22,000 psi	10,600 psi
Design Stress		2,000 psi	1,500 psi	2,000 psi	1,000 psi	2,000 psi	1,250 psi
Hydrostatic Burst							
Ultimate Hoop Stress 2" - 6"	ASTM D1599	71,000 psi	81,000 psi	63,000 psi	66,000 psi	–	–
Ultimate Hoop Stress 8" - 12"	ASTM D1599	40,000 psi	40,000 psi	30,000 psi	45,000 psi	–	–
Ultimate Hoop Stress All Sizes	ASTM D1599	–	–	–	–	36,000 psi	41,000 psi
Hydrostatic Design	ASTM D2992						
Cyclic 150×10^6 Cycles	Procedure A	5,150 psi	5,000 psi	6,800 psi	4,500 psi	6,000 psi	5,800 psi
Static Basis 10^5 hours	Procedure B	15,300 psi	15,300 psi	(2)	(2)	(2)	(2)
Static Design (1) at 10^5 hours		7,650 psi	7,650 psi	–	–	–	–
Coefficient of Linear Thermal Expansion							
Sizes 2" thru 6"	AOS-I TM	1.35×10^{-5} in/in/°F		1.22×10^{-5} in/in/°F		———	
Sizes 8" thru 12"	AOS-I TM	0.88×10^{-5} in/in/°F		0.88×10^{-5} in/in/°F		———	
All Sizes	AOS-I TM	———		———		1.14×10^{-5} in/in/°F	

PROPERTY	TEST METHOD	CHEMLINE 75°F	CHEMLINE 225°F	POLY THREAD 75°F	POLY THREAD 200°F
Axial Tensile					
Ultimate Stress	ASTM D2105	6,550 psi	6,000 psi	9,100 psi	4,400 psi
Design Stress		1,640 psi	1,500 psi	2,275 psi	1,100 psi
Modulus of Elasticity	ASTM D2105	1.7×10^6 psi	1.04×10^6 psi	1.4×10^6 psi	0.7×10^6 psi
Axial Compression					
Ultimate Stress	ASTM D695	34,400 psi	21,400 psi	16,700 psi	16,300 psi
Design Stress		8,600 psi	5,350 psi	4,175 psi	4,075 psi
Modulus of Elasticity		2.12×10^6 psi	1.33×10^6 psi	1.39×10^6 psi	0.74×10^6 psi
Beam Bending					
Ultimate Stress	AOS-I TM	22,300 psi	13,000 psi	21,500 psi	9,300 psi
Design Stress		2,000 psi	1,500 psi	2,000 psi	1,000 psi
Hydrostatic Burst					
Ultimate Hoop Stress All Sizes	ASTM D1599	21,625 psi	21,625 psi	44,000 psi	30,850 psi
Hydrostatic Design	ASTM D2992				
Cyclic 150×10^6 Cycles	Procedure A	4,950 psi	4,950 psi	4,400 psi	3,200 psi
Static Basis 10^5 hours	Procedure B	(2)	(2)	(2)	(2)
Static Design (1) at 10^5 hours		–	–	–	–
Coefficient of Linear Thermal Expansion					
Sizes 2" thru 6"	AOS-I TM	———		———	
Sizes 8" thru 12"	AOS-I TM	———		———	
All Sizes	AOS-I TM	1.08×10^{-5} in/in/°F		1.05×10^{-5} in/in/°F	

(1) Service Factor of 0.5 applied to static basis

(2) Data not available at time of printing

TABLE I.2
PIPE DIMENSIONS, WEIGHTS, AND CAPACITY

TYPE	Size	Nominal O.D. (In.)	Nominal I.D. (In.)	Nominal Total Wall Thick-ness (In.)	Nominal Reinforced Wall Thickness (In.)	Nominal Weight (Lbs./Ft.)	Nominal Capacity (Gal./Ft.)	(Cu.Ft./Ft.)
RED THREAD RTP-70	2"	2.375	2.235	.070	.070	0.4	.20	.0274
	3"	3.500	3.360	.070	.070	0.6	.47	.0623
	4"	4.500	4.360	.070	.070	0.8	.78	.1042
	6"	6.625	6.405	.110	.110	1.7	1.67	.2238
	8"	8.636	8.352	.142	.142	3.2	2.85	.3812
	10"	10.694	10.350	.172	.172	4.8	4.37	.584
	12"	12.680	12.270	.205	.205	6.0	6.14	.8207
RED THREAD RTP-190	2"	2.380	2.000	.190	.190	1.19	.16	.0217
	2½"	2.821	2.441	.190	.190	1.32	.24	.0325
SILVER THREAD	2"	2.375	2.235	.070	.070	0.4	.20	.0274
	3"	3.500	3.360	.070	.070	0.6	.47	.0623
	4"	4.500	4.360	.070	.070	0.8	.78	.1042
	6"	6.625	6.405	.110	.110	1.7	1.67	.2238
	8"	8.636	8.352	.142	.142	3.2	2.85	.3812
	10"	10.694	10.350	.172	.172	4.8	4.37	.584
	12"	12.680	12.270	.205	.205	6.0	6.14	.8207
GREEN THREAD	1"	1.335	1.191	.072	.048	0.2	.06	.0078
	1½"	1.920	1.756	.082	.058	0.4	.13	.0169
	2"	2.375	2.147	.114	.090	0.6	.19	.0251
	3"	3.500	3.272	.114	.090	0.9	.44	.0584
	4"	4.500	4.272	.114	.090	1.2	.74	.0995
	6"	6.625	6.337	.144	.120	2.4	1.64	.2190
	8"	8.676	8.352	.162	.138	3.4	2.85	.3812
	10"	10.734	10.350	.192	.168	5.0	4.37	.584
	12"	12.714	12.270	.222	.198	7.1	6.14	.8207
CHEMLINE	2"	2.455	2.235	.110	.095	0.7	.20	.0274
	3"	3.580	3.360	.110	.095	1.0	.47	.0623
	4"	4.580	4.360	.110	.095	1.3	.78	.1042
	6"	6.625	6.295	.165	.135	2.6	1.62	.2160
POLY THREAD	2"	2.375	2.135	.120	.096	0.6	.19	.0249
	3"	3.500	3.260	.120	.096	0.9	.43	.0579
	4"	4.500	4.260	.120	.096	1.2	.74	.0989
	6"	6.625	6.295	.165	.141	2.6	1.62	.2160
	8"	8.676	8.364	.156	.132	3.1	2.85	.3814
	10"	10.734	10.382	.176	.152	4.3	4.40	.5876
	12"	12.714	12.304	.205	.181	6.1	6.17	.8253
	14"	14.480	14.000	.240	.216	8.1	7.99	1.068
	16"	16.540	16.000	.270	.246	10.5	10.44	1.396

NOTE: All values are nominal values. Tolerances or maximum/minimum limits can be obtained from A. O. Smith-Inland Inc.

SECTION 2
JOINING SYSTEMS

A. O. Smith-Inland offers a choice of proven joining methods. Each has distinct advantages in a given application and you can select the method most suitable to your installation requirements.

A. PIPE AND FITTINGS CONNECTIONS

BELL AND SPIGOT – This is the primary method used for joining A. O. Smith-Inland systems and is the result of extensive research and development. This joint has been proven by years of field installation in all types of service. In this system, the pipe is supplied with one end tapered and the other end belled or fitted with a coupling to accept a taper. The joint is secured with an adhesive designed to complement the operating conditions of the pipe system employed. The fittings are also manufactured to accept the tapered end of the pipe. The taper can be readily applied to the pipe in the field with a tool specifically made for the purpose.

The precise taper system insures those requirements necessary for a strong joint – uniform adhesive distribution, thin bond line and natural locking action. The latter is of additional benefit in installation, as the locking effect of the taper maintains the joint in position while the adhesive cures, allowing the work to proceed.

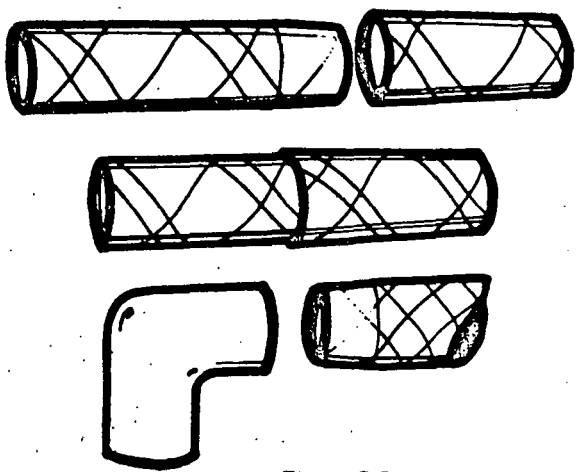


Figure 2.0
Bell and Spigot

THREADED AND BONDED (T.A.B.)™ JOINT – Our exclusive Threaded and Bonded (T.A.B.) Joint on 2" through 6" RED THREAD and SILVER THREAD improves the reliability of an already reliable bell and spigot joint. It reduces the opportunity for installation errors under all temperature conditions.

This joining system combines both threads and adhesive on the bonding surfaces. Both bell and spigot ends of the pipe are threaded with our unique profile double-lead threads.

The mechanical locking action of these threads promotes positive make up which prevents backout during adhesive curing. In addition, the locking action permits some movement of the pipe before adhesive cure. It's especially helpful on installations over rough or uneven terrain or under low temperature conditions. And installation is still fast and easy; the threads lock with only a few turns of the pipe.

No need to carry a double inventory just to use our new joint system. When bonding our T.A.B. Joint to nonthreaded bell and spigots or fittings, the adhesive bond is as strong as a conventional joint.

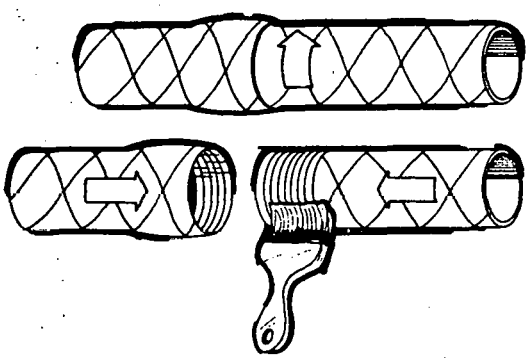


Figure 2.1
T.A.B. Joint

REDI-THRED®– The REDI-THRED joint system is designed for rapid assembly of long runs of pipe. Each 30' length of 2", 3" or 4" RED THREAD is supplied with the REDI-THRED coupling factory installed.

The REDI-THRED couplings require no adhesive. Joints are completed in seconds without turning the entire pipe . . . just the threaded collar. Ideal for wet or cold weather use, and for temporary or permanent lines.

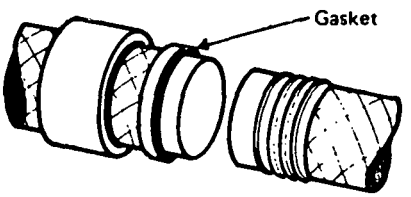


Figure 2.2
REDI-THRED

SECTION 4
SUPPORTS, ANCHORS, GUIDES

ABOVE GROUND INSTALLATIONS

Above ground installations can be broadly divided into two categories – lines which are laid directly on the surface of the ground and those which are hung or supported as in a typical plant. In either case, there are certain basic guidelines to be followed:



Figure 4.0
Excessive Bending

On any lines laid directly on the surface, care should be taken to insure that there are no excessive bends that would impose undue stress on the pipe, and that adequate protection is provided in areas where possible mechanical damage could occur. If the line is connected into a system which could impart a vibration or pulsing action to the pipe, areas of contact with supports should be protected to prevent the pipe from abrading as shown in Figure 4.1.



Figure 4.1
Point Loading

A. SUPPORTS: Horizontal pipe should be supported at intervals suggested by the support spacing data in Figures 4.14 through 4.18. Supports that have point contact or narrow supporting areas should be avoided, and valves or other heavy equipment should be supported independently of the pipe. (Figures 4.2 and 4.3)

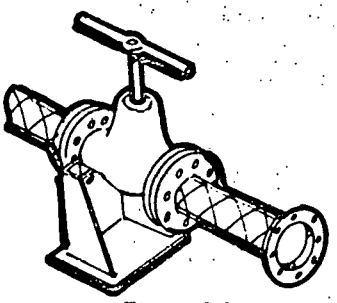


Figure 4.2
Supports for Valves

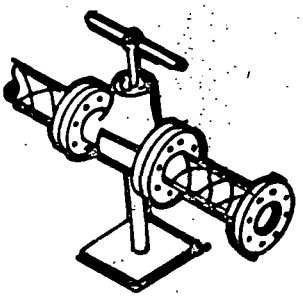
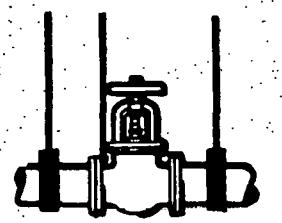


Figure 4.3
Supports for Valves



When possibility exists that valve will be removed periodically, pipe should be supported on both sides of valve.

Figure 4.4
Removable Valve Supports

Standard sling, clamp and clevis hangers and shoe supports designed for use with steel pipe can be used to support A. O. Smith-Inland pipe. (Figures 4.5 through 4.10). Any other type of support that gives a wide band of contact with at least 120° of contact with the pipe can be used.

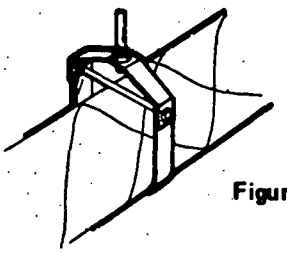


Figure 4.5

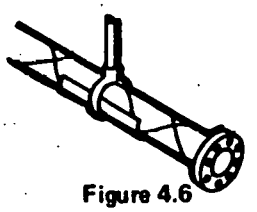


Figure 4.6

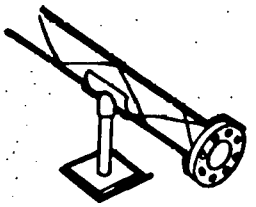


Figure 4.7



Figure 4.8



Figure 4.9

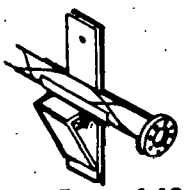


Figure 4.10

Figures 4.5 thru 4.10
Hangers and Other Pipe Supports

RED THREAD SPECIFICATION STATEMENT

I. RAW MATERIALS

Glass Fiber — Continuous single end EK-37s with an epoxy compatible binder and epoxy compatible silane coupling agent. Each strand of EK-37s to be individually tensioned during pipe and fittings manufacture.

Resin Formulation — Stoichiometric ratio of bisphenol A — epichlorohydrin epoxy resins and any of the following aromatic amine curing agents:

Metaphenylene diamine
Methylene dianiline
Diamino diphenyl sulfone

II. PROCESS

Pipe Winding — Pipe will be filament wound using the above raw materials with fiber glass oriented at helix angle of 35¼° as measured from the vertical axis. The resin content shall be 28% by weight. The pipe shall be completely cured at an elevated temperature so that subsequent methylene chloride solvent extractables of less than 5% are obtained (pipe to be finely ground, solvent extracted at room temperature for one hour).

In-Line Fittings — These are to be filament wound at a helix angle of 35¼° using individually tensioned, continuous single strands of EK-37s glass fiber and a liquid epoxy resin system mentioned above, cured at an elevated temperature until methylene chloride extractables of less than 5% are obtained. Resin content shall be 28% minimum.

Molded Fittings — Compression molded using an epoxy molding compound with strength, thermal and chemical resistances at least as good as the pipe and in-line fittings. This molding compound reinforced with a minimum of 60% chopped glass fiber. The molded fittings cured at an elevated temperature until methylene chloride extractables of less than 5% are obtained.

III. JOINING TECHNIQUES

The pipe and fittings will be able to be joined with an epoxy adhesive on matching tapered bell and spigot. The adhesive consisting of a compatible epoxy resin cured with an aliphatic amine. Material to be installed in accordance with AOS-I installation manual No. 9474.

IV. PRESSURE RATING

The entire piping system (pipe, fittings and adhesive joints) shall be pressure rated using ASTM Test Method D-2992 titled, "Standard Method for Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings". Minimum continuous pressure rating — 150 psi to 150°F.

SILVER THREAD GENERAL SPECIFICATIONS

SCOPE

Pipe — Pipe shall be manufactured by A. O. Smith-Inland Inc. by the filament winding process using a thermosetting epoxy resin to impregnate strands of continuous glass filaments which are wound around a straight mandrel at a prescribed helix angle and under controlled tension. All pipe will be supplied with a matching tapered integral bell and tapered spigot or tapered coupling and a matching tapered spigot.

WORKING LIMITS

Minimum continuous pressure rating 150 psi at 210°F in determined accordance with ASTM Standard Method of Test D2992 — Procedure A. Consult manufacturer's catalog for more detailed information.

CONSTRUCTION

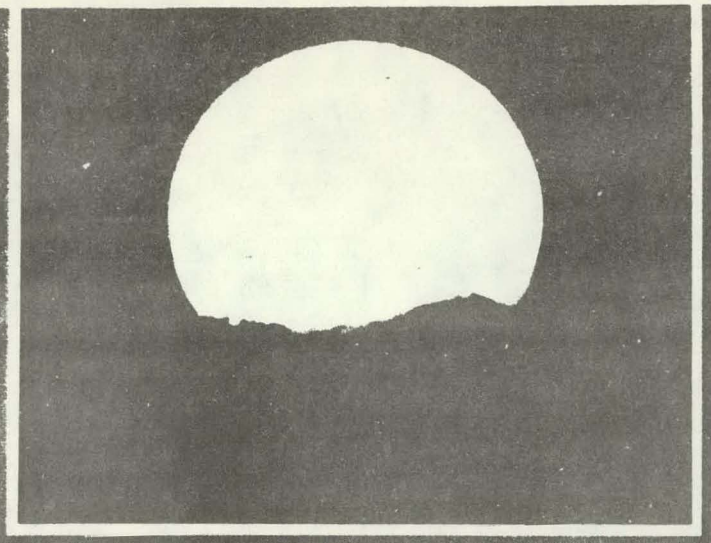
2" thru 12" — SILVER THREAD pipe shall have continuous glass fibers filament wound at 35¼° helix angle in a matrix of epoxy resin pigmented to resist ultraviolet degradation. Pipe shall be in compliance with ASTM Specification D2996-71 and classified by its designation code as shown in Table 11.1. Pipe shall meet all dimensional and performance requirements, mechanical properties, and shall be marked with the following designation codes.

TABLE 11.1

SIZE	DESIGNATION CODE AT 73.4°F
2" - 4"	RTRP-11AE-4111
6"	RTRP-11AE-4112
8" - 10"	RTRP-11AE-2112
12"	RTRP-11AE-2114

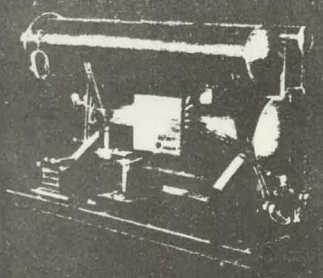
ARKLA

ABSORPTION CHILLER



solaire® 300

25 ton Absorption Chiller for Solar Air Conditioning



ARKLA solaire®

SUN POWERED AIR CONDITIONING

A product of Arkla Industries Inc.

General Description

Arkla's Solaire 300 water chiller is designed primarily for solar cooling applications but can be used for a broad range of comfort air conditioning and industrial process applications. With firing water temperature between 160°F and 200°F, and with 85°F condensing water, the machine can produce from 7.5 tons to 26.5 tons of cooling capacity.

Features

- The unit is nominally rated at 25 tons, but design flexibility allows easy adaptation for a wide range of capacities.
- The special lithium bromide/water solution is installed at the factory and each machine is given a complete capacity test.
- The low concentration of the solution reduces the possibility of crystallization to an insignificant status.
- The hermetically sealed centrifugal pumps are electrically driven. This pump transfers solution from the low pressure side to the high pressure side of the absorption cycle.
- The combination of the solution pump and the [illegible] face permits the unit to produce practical cooling capacity from refrigerant to firing water temperatures.
- The generator may be [illegible] shell-and-tube type [illegible]

Operating Controls

- **Three-Way Hot Water Control Valve**—The amount of hot water to the generator is controlled by the cooling load. With low cooling loads the hot water control valve is partially closed, and a portion of the hot water is diverted back to the thermal storage tank or the solar collector system. When the cooling load drops to a point where hot water flow is minimal, the valve closes and an end switch will cause the unit to shut down.
- **Two Input Controller**—With two temperature sensing bulbs, one for leaving chilled water and one for returning chilled water, this solid state device controls the operation of the three-way hot water control valve.
- **Solution By-Pass Valve and Timer**—On start-up, this valve opens causing solution to by-pass the absorber for [illegible] minutes. Other [illegible] until the chiller is put on a load.
- **Concentration Chamber Dump Valve**—If the temperature of the condensing water fails to approximately 70°F, the concentration [illegible] dilute [illegible] chamber [illegible] crystallization [illegible]
- **Pump Control Relays**—[illegible]

Safety Controls

- **Evaporator Low Temperature Switch**—If the refrigerant in the flash chamber falls below minimum temperatures, this safety switch will cause the hot water control valve to close and divert all the hot water around the generator. It will also shut down both the solution pump and the condensing water pump.
- **Chilled Water Low Temperature Switch**—This safety switch performs the same function as the evaporator low temperature switch but senses the temperature of the leaving chilled water.
- **Condenser High Temperature Limit Switch**—If the temperature of the condenser rises above acceptable limits, this safety switch will also cause the hot water control valve to close and divert the firing water around the generator.
- **Chilled Water Flow Switch**—If the flow of [illegible] switch will shut down the machine in the same manner as the evaporator low temperature switch.
- **Thermal Delay Relay, Lockout Relay and Timer**—[illegible] by the [illegible] water [illegible] the unit [illegible] a timed [illegible]

SPECIFICATIONS

MODEL WFB 300

DESIGN DELIVERED CAPACITY, Btu/h . . . . . 306,000[1]

DESIGN DELIVERED CAPACITY, Tons I.M.E. . . . . 25.5[1]

ENERGY REQUIREMENTS

Design Hot Water Input, Btu/h	447,000
Design Hot Water Inlet Temperature, °F	195
Design Hot Water Outlet Temperature, °F	184.8
Permissible Range of Inlet Temp.	160 to 200
Design Hot Water Flow, gpm	90
Pressure Drop, Feet of Water, at 90 gpm	20.7
Permissible Range of Flow, gpm	50 to 100
Pressure Drop, Feet of Water, at 100 gpm	25.6
Maximum Working Pressure, psig	100
Electrical Voltage, 60 Hz, 1 Phase	115[2]
Maximum Wattage Draw	300

CHILLED WATER DATA

Design Inlet Temperature, °F	55
Design Outlet Temperature, °F	45
Design Flow, gpm	60
Pressure Drop, Feet of Water, at 60 gpm	9.8
Permissible Range of Flow, gpm	30 to 100
Pressure Drop, Feet of Water, at 100 gpm	26.9
Maximum Working Pressure, psig	100
Unit Water Volume, Gallons, Approx.	12
Fouling Factor	.0005

CONDENSING WATER DATA

Design Heat Rejection, Btu/h	753,000
Design Inlet Temperature, °F	85
Design Outlet Temperature, °F	101.7
Permissible Range of Inlet Temp.	75 to 90
Design Flow, gpm	90
Pressure Drop, Feet of Water, at 90 gpm	22.9
Permissible Range of Flow, gpm	50 to 110
Pressure Drop, Feet of Water, at 110 gpm	33.5
Maximum Working Pressure, psig	100
Unit Water Volume, Gallons, Approx.	20
Fouling Factor	.001

FOR COOLING TOWER SELECTION

Maximum Heat Rejection, Btu/h	853,000
Range, °F	16 to 17
Minimum Permissible Sump Temperature, °F	75[3]

SERVICE CONNECTIONS

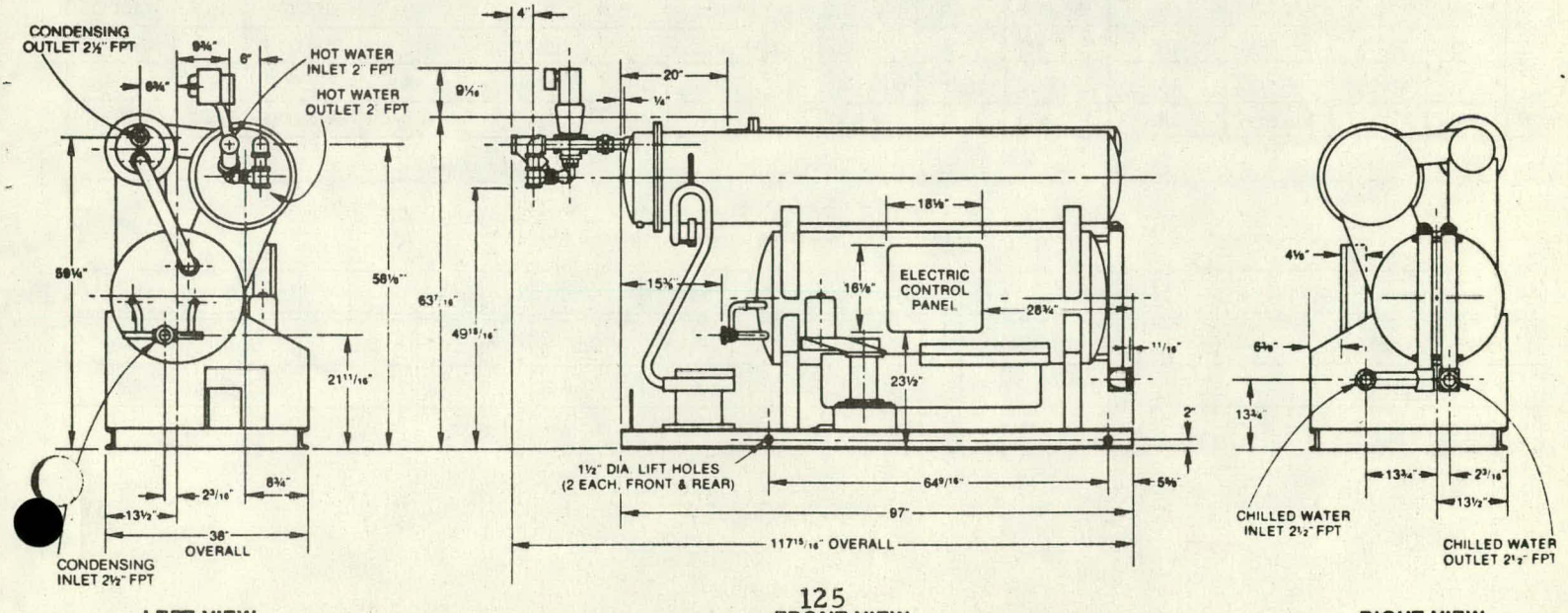
Hot Water Inlet and Outlet	2" FPT
Chilled Water Inlet and Outlet	2½" FPT
Condensing Water Inlet and Outlet	2½" FPT

PHYSICAL DATA, APPROXIMATES

Operating Weight, Pounds	3,420[4]
Shipping Weight, Pounds	3,145[5]
Crated Size, Inches	114 W, 45 D, 69 H

NOTES: 1. Capacity at design conditions. For capacities at other conditions, see Page 4.
2. Units equipped for operation on 230V-50Hz-1Ph available on special order.
3. Thermostatic switch to control tower fan MUST be used. Set to "cut out" at 75°F.
4. Includes circulating water weights.
5. Units as shipped contain Lithium Bromide charge.
Application Manual (SA-41080) Available.

DIMENSIONAL VIEWS



MODEL WFB 300 CAPACITY DATA

Condensing Water Flow: 90 gpm
Chilled Water Flow: 60 gpm
Hot Water Flow: 90 gpm
Temperatures in Degrees Fahrenheit

	Hot Water Inlet Temp.	Hot Water Outlet Temp.	Energy Input Btu/h	Leaving Chilled Water Temp.	DELIVERED CAPACITY Btu/h	DELIVERED CAPACITY Tons	Heat to be Rejected Btu/h
85° Inlet Condensing Water	160	157.0	132,000	40	66,000	5.5	198,000
		156.6	149,200	45	88,800	7.4	238,000
		156.0	175,900	50	102,000	8.5	277,900
	165	161.1	172,600	40	98,400	8.2	271,000
		160.5	197,900	45	129,600	10.8	347,500
		159.9	227,600	50	145,000	12.1	372,600
	170	165.1	214,300	40	132,000	11.0	346,300
		164.5	240,700	45	166,800	13.9	407,500
		164.0	262,400	50	180,000	15.0	442,400
	175	169.1	257,000	40	163,200	13.6	420,200
		168.7	277,600	45	196,800	16.4	474,400
		168.2	297,500	50	213,600	17.8	511,100
	180	173.1	302,400	40	192,000	16.0	494,400
		172.9	313,800	45	224,400	18.7	538,200
		172.2	341,200	50	246,000	20.5	587,200
	185	176.9	352,300	40	218,400	18.2	570,700
		176.8	354,900	45	252,000	21.0	606,900
		176.3	380,700	50	276,000	23.0	656,700
	190	180.9	396,000	40	237,600	19.8	633,600
		180.8	400,000	45	276,000	23.4	676,000
		180.4	421,500	50	306,000	25.5	727,500
	195	184.7	448,700	40	258,000	21.5	706,700
		184.8	446,700	45	306,000	25.5	752,700
		184.6	451,600	50	328,800	27.4	780,400
	200	188.7	490,900	40	270,000	22.5	760,900
		189.0	481,800	45	318,000	26.5	799,800
		188.6	493,200	50	360,000	30.0	853,200
90° Inlet Condensing Water	165	162.8	96,800	45	60,000	5.0	156,800
	170	166.9	139,100	45	96,000	8.0	235,100
	175	170.7	188,000	45	134,000	11.2	322,400
	180	174.7	234,000	45	168,000	14.0	402,000
	185	178.7	274,000	45	195,600	16.3	469,600
	190	182.5	327,900	45	225,600	18.8	553,400
	195	186.6	365,500	45	237,600	19.8	603,100
	200	190.4	414,500	45	252,000	21.0	666,500

Condensing Water Flow: 90 gpm
Chilled Water Flow: 60 gpm
Hot Water Flow: 90 gpm
Temperatures in Degrees Fahrenheit

	Hot Water Inlet Temp.	Hot Water Outlet Temp.	Energy Input Btu/h	Leaving Chilled Water Temp.	DELIVERED CAPACITY Btu/h	DELIVERED CAPACITY Tons	Heat to be Rejected Btu/h
80° Inlet Condensing Water	160	156.1	174,200	40	108,000	9.0	282,200
		155.9	189,000	45	115,200	9.6	296,200
	165	160.3	240,000	40	138,000	11.5	348,000
		159.9	227,500	45	152,400	12.7	379,900
	170	164.1	259,000	40	174,000	14.5	432,900
		163.6	270,900	45	189,600	15.8	460,500
	175	168.0	306,700	40	206,400	17.2	513,100
		167.7	321,100	45	228,000	19.0	549,100
	180	172.0	351,800	40	236,400	19.7	588,200
		171.8	357,500	45	259,200	21.6	616,700
	185	176.0	395,700	40	260,400	21.7	656,100
		175.7	405,000	45	291,600	24.3	696,600
	190	179.8	446,200	40	282,000	23.5	728,200
		179.7	449,800	45	321,600	26.8	771,400
	195	183.6	500,000	40	300,000	25.0	800,000
		183.7	492,000	45	344,400	28.7	836,400
	200	187.3	547,400	40	312,000	26.0	859,400
		187.8	527,900	45	360,000	30.0	887,900

FOR 15 TON OPERATION

Data in following table are with flows adjusted for 15 ton operation.
Condensing Water Flow: 54 gpm Hot Water Flow: 54 gpm
Chilled Water Flow: 36 gpm Temperatures in Degrees Fahrenheit

85° Inlet Condensing Water	165	160.4	122,000	45	72,000	6.0	194,000
	170	164.3	151,400	45	98,000	8.2	249,800
	175	167.9	186,600	45	128,400	10.7	315,000
	180	171.6	220,800	45	157,200	13.1	378,000
	185	175.4	253,300	45	182,400	15.2	435,700
	190	179.2	284,100	45	204,000	17.0	488,100
	195	183.1	312,700	45	222,000	18.5	534,700
	200	187.1	334,300	45	234,000	19.0	568,300

PRESSURE DROP for Pump Sizing
In Feet of Water at Flow Rate, Gallons per Minute

Flows, gpm	30	40	50	60	70	80	90	100	110
Hot Water Circuit	NA	NA	6.6	9.4	12.7	16.7	20.7	25.6	NA
Chilled Water Circuit	2.5	4.4	6.8	9.8	13.4	17.4	21.8	26.9	NA
Condensing Water Circuit	NA	NA	7.4	10.5	14.1	18.3	22.9	27.8	33.5

Where Progress Is Built On Quality

Arkla Industries Inc.
P.O. Box 534
Evansville, IN 47704

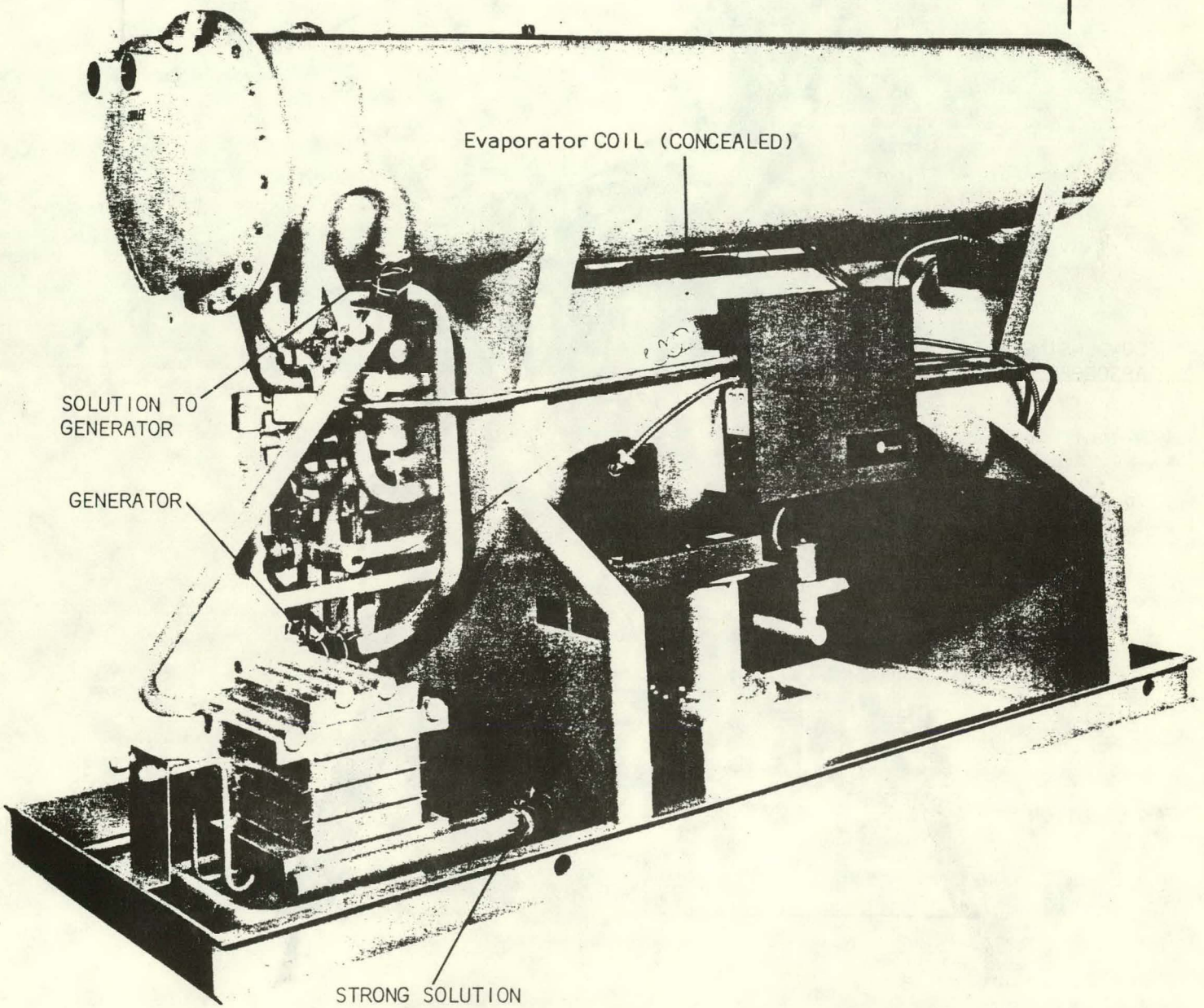
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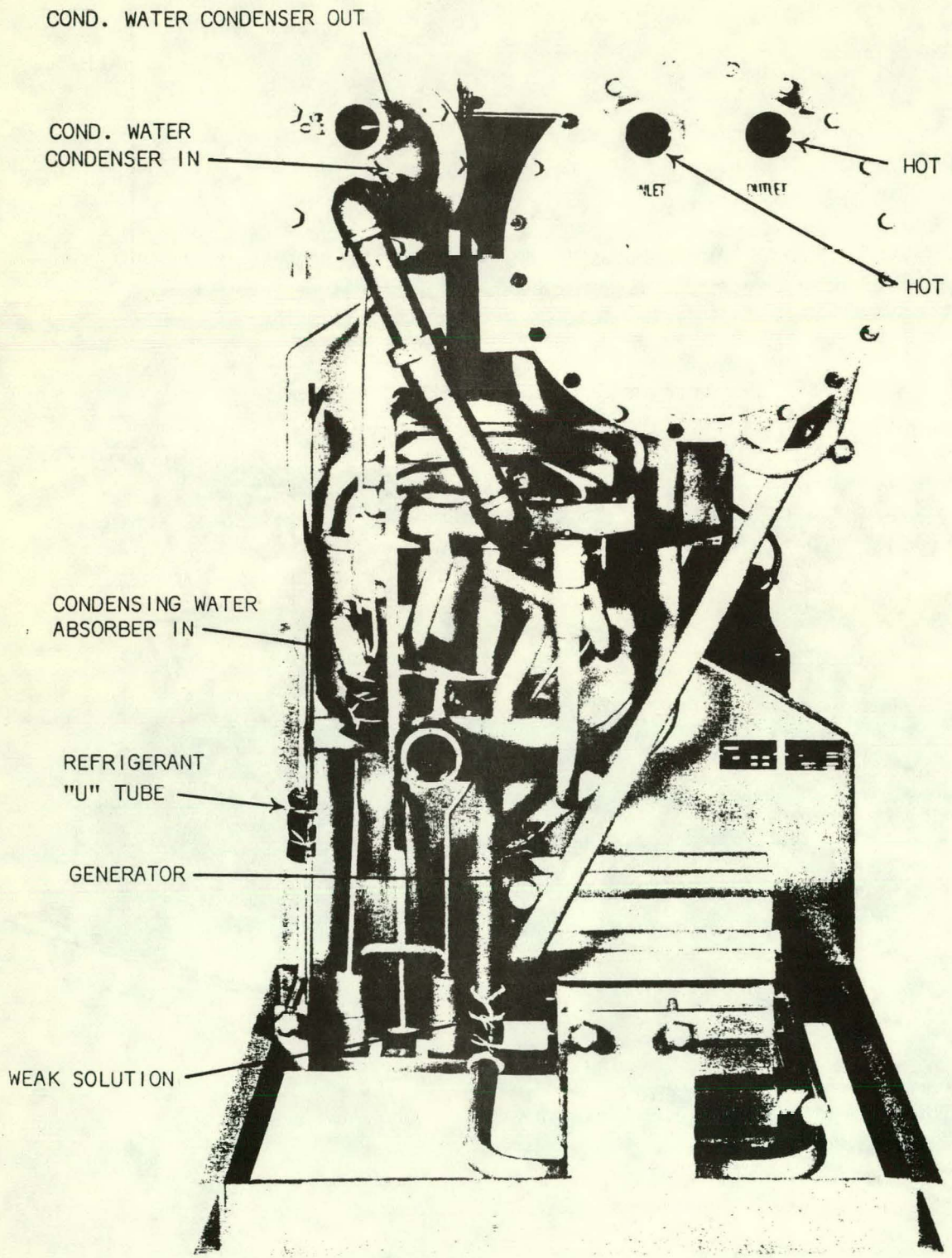
THERMOMETER WELL LOCATIONS

MODELS

WFB-300



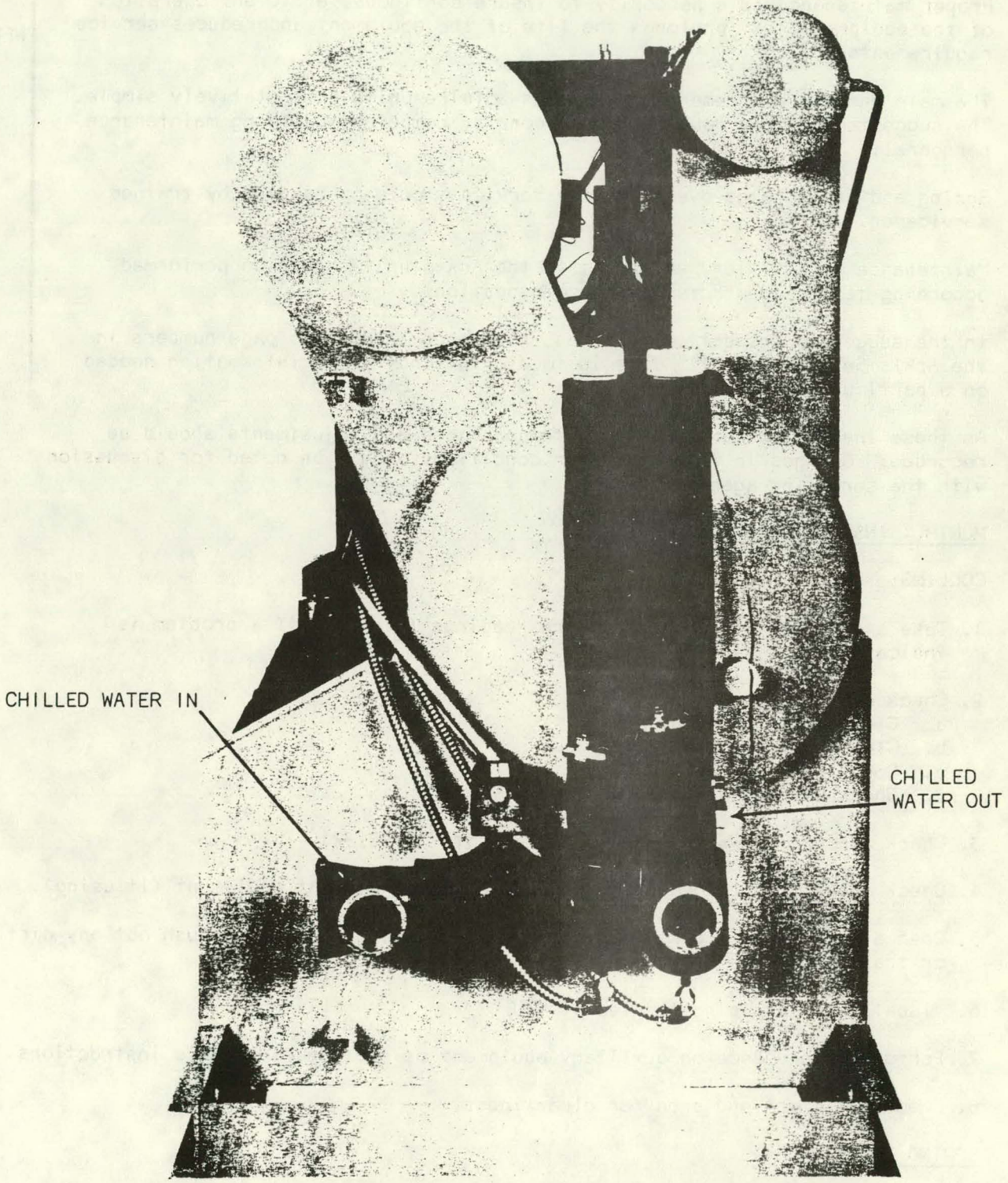
THERMOMETER WELL LOCATIONS



LEFT END VIEW

ARKLA INDUSTRIES INC. P.O. BOX 534 EVANSVILLE, INDIANA 47704

THERMOMETER WELL LOCATIONS



RIGHT END VIEW

MAINTENANCE

Proper maintenance is a necessity to insure continous, efficient operation of the equipment. It prolongs the life of the equipment and reduces service requirements.

The maintenance requirements on Arkla's Solaire Units are relatively simple. The suggested monthly routine can be done by competent building maintenance personnel.

Spring and fall change-overs and any service should be handled by trained servicemen.

Maintenance on auxiliary equipment to the Arkla unit should be performed according to the manufacturer's recommendations.

In the suggested inspection routines, reference is made to page numbers in the Arkla Service Manual. This is to aid in finding the information needed on a particular subject.

As these inspections are made, all temperatures and adjustments should be recorded. Changes in temperature or conditions should be noted for discussion with the servicing agency.

MONTHLY INSPECTIONS

COOLING:

1. Take a complete set of temperature readings (VI-15). If a problem is indicated, call servicing agency.

2. Check cooling tower;
   a. Cleanliness of sump.
   b. Cleanliness of sump screen.
   c. Condition of fan belt.
   d. Check water distribution system.

3. Check condensing water bleed-off flow rate (IV-35-2)

4. Check operation of condensing water chemical treatment equipment (if using).

5. Open all valves, on dirt legs and strainers, long enough to flush out any dirt or trash.

6. Visually check piping for leaks.

7. Perform maintenance on auxiliary equipment as per manufacturer's instructions.

8. Check equipment and area for cleanliness.

SPRING START-UP

A. TOWER

1. Clean and flush distribution system and sump and sump strainer.

2. Replace all drain plugs, clean strainers, and close all drain valves.
3. Start filling tower sump.
4. Perform maintenance on tower fan motor and pump motor as per manufacturer's instructions.
5. Check condition and adjustment of tower fan belt.
6. When tower sump is filled, check adjustment of water level control.
7. Check fuses, start the condensing water pump.
8. After full flow of condensing water has been established, check the bleed-off flow rate (IV-35-2).
9. Check operation of condensing water chemical treatment equipment (if using).
10. After condensing water has been flowing at least 10 minutes, shut off pump.
11. Open valves on dirt legs and strainers and flush out any mud or trash.

B. UNIT

1. Perform maintenance on water pumps as per manufacturer's recommendations.
2. Check level of unit (IV-11-4).
3. Turn off manual hot water valve and then put unit into operation electrically.
4. Open valves on dirt legs just long enough to drain out any dirt or trash.
5. Clean filters.
6. Purge all air from chilled water system.
7. Check water piping for leaks.
8. Check chilled water flow rate (IV-25-4).
9. Check anti-freeze concentration (IV-29-2).
10. Check condensing water flow rate through unit (IV-32-4)
11. Check hot water flow rate through unit (IV-43-9).

C. CONTROLS

1. Check operation of weak solution by-pass valve and timer. See (V-75-4), (V-46-3(B))
2. Check operation of tower fan sump switch. (IV-38-2)
3. Check operation of condensing water switch. (V-19-2)
4. Check operation of refrigerant dump valve. (V-16-2)

5. Check operation of chilled water low temperature switch.(V-12-4)

6. Check operation of flow switch. (V-15-1)

7. Check operation of evaporator low temp switch. (V-11-3)

8. Check hot water valve modulation. (IV-43-10)

9. Check all external controls in the system.

D. OPERATIONAL CHECK

1. Place thermometers in all thermometer wells (VI-15-6(A),(B),(C)).

2. Operate unit on cooling for at least 30 minutes or until all temperatures have stabilized.

3. Record temperatures.

SHUT DOWN

A. TOWER

NOTE: If the condensing water system could be subjected to sub-freezing temperatures it is recommended that the system be flushed with a mixture of anti-freeze and water after performing the shut down procedure given below. This mixture should be capable of withstanding the lowest expected ambient temperature.

1. Close valve in tower make-up water line.

2. Open all drain valves and remove all plugs in condensing water system.

3. Clean and flush tower's distribution system.

4. Clean and flush tower sump.

5. Clean all strainers in condensing water system.

6. Circulate anti-freeze through condensing water circuit.

7. Remove fuses so that condensing water pump or tower fan cannot accidentally be operated without water.

B. UNIT

1. Turn off unit.

2. Open all valves to drain the condensing water circuit.

3. Turn off manual hot water supply valve to the unit. Open drain valves.

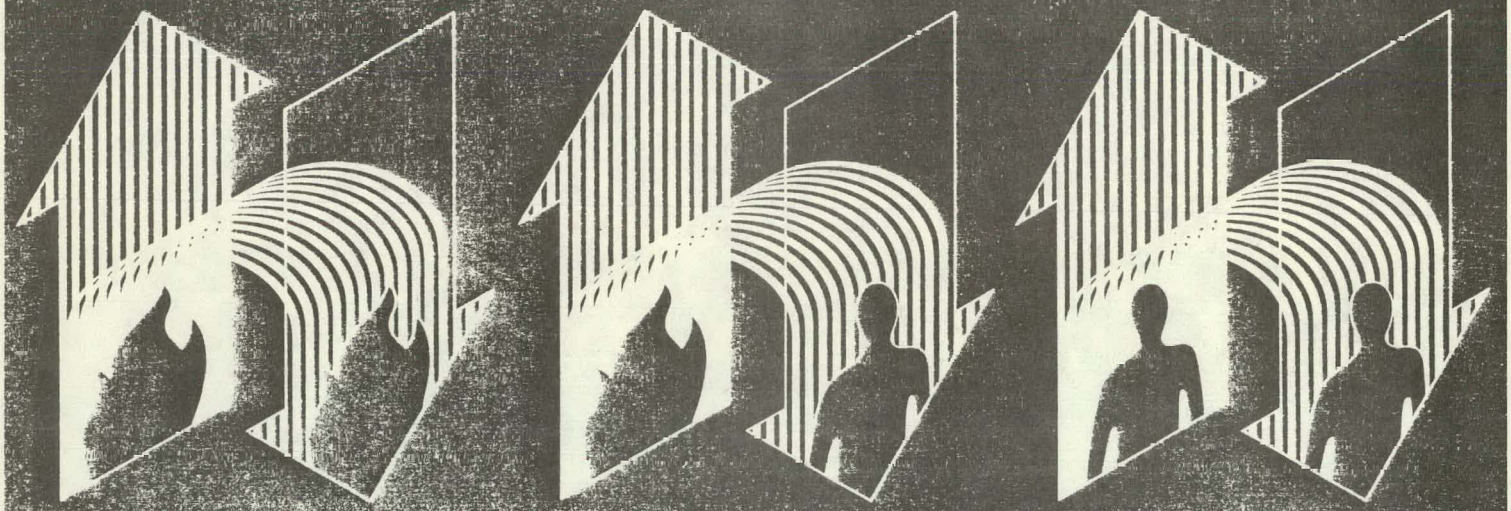
4. Check anti-freeze concentration (IV-29-2) and close chilled water valves at unit.

5. Touch up all rusty areas on unit by painting. Arkla Part No. Z-3181 Pizzaz (Orange Paint), or Gliddens Poly Urethane Floor Enamel, Color No. 15157(Tinted).

HEAT PIPE

HEAT RECOVERY

heat pipe heat recovery



Why Heat Recovery

In most commercial and industrial operations, there is a large amount of energy lost as waste heat that is typically exhausted into the atmosphere. No serious attempt has been made to recover this waste heat in the past, since, until recently, traditional forms of energy have been both abundant and relatively inexpensive.

This has changed drastically with the advent of increased prices that are projected to double or triple in the next five years, and fuel curtailments. Both affect present operations and threaten to limit future expansions without the availability of increased fuel supplies.

Today, air-to-air heat recovery has become an important means of reducing both growing costs and consumption. The Hughes HeatBank™ air-to-air heat recovery unit is currently being used in many commercial and industrial applications. Payback is attractive now and doubly attractive over the life of the HeatBank.

Heat Recovery in Industry

Although industrial heat recovery presents a series of difficult design considerations with respect to high exhaust temperature, corrosive atmospheres and dirty air, it also presents the greatest opportunity for saving large amounts of waste BTUs. High temperature differentials, large air volumes, and many hours of operation make heat recovery a necessary consideration for any industrial heat user whether he is considering a new installation or retrofit.

The basic types of industrial air-to-air heat recovery can be characterized as process-to-process where heat is recovered from the exhaust air and returned to the process; process-to-comfort where exhaust heat is recovered and used in comfort heating; and process exhaust temperature limiting as in the case of pollution control equipment.

Heat Recovery in Heating, Ventilating and Air-Conditioning

Heat recovery involving heating, ventilating and air-conditioning (HVAC), is a viable way of conserving energy dollars for both retrofit and new construction systems. In new construction, not only are energy savings and reduced fuel costs realized, but the initial costs of the heating and cooling plant can be significantly reduced. Retrofit heat recovery is particularly attractive in systems which require 100% air change or where process exhausts can be used for space heating.

HVAC systems are characterized by large clean airflows and relatively low exhaust temperatures which mean low-cost standard materials of construction may be used. Important design considerations associated with HVAC systems are condensation, frost protection, and temperature output control.

The basic types of commercial recovery are comfort-to-comfort where the building exhaust heat is returned to the comfort conditioning system; and process-to-comfort make-up air systems. Comfort systems can also be further broken down into heating only, cooling only, or heating and cooling.

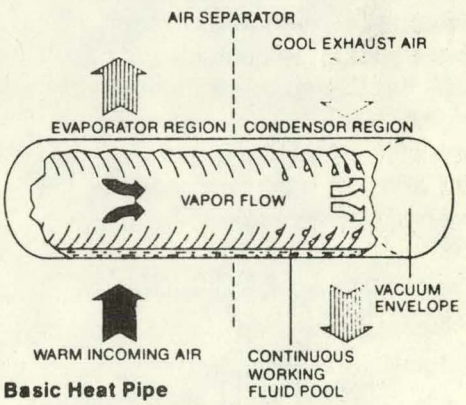
What is The Hughes HeatBank Unit

The HeatBank unit has been designed for highly efficient recovery of waste heat in air-to-air applications. The units are completely passive heat exchangers that utilize the unique features of Hughes' heat pipes. The pipes transfer heat from the warm exhaust airstream to the cooler incoming airstream or from a warm incoming to a cooler exhaust airstream.

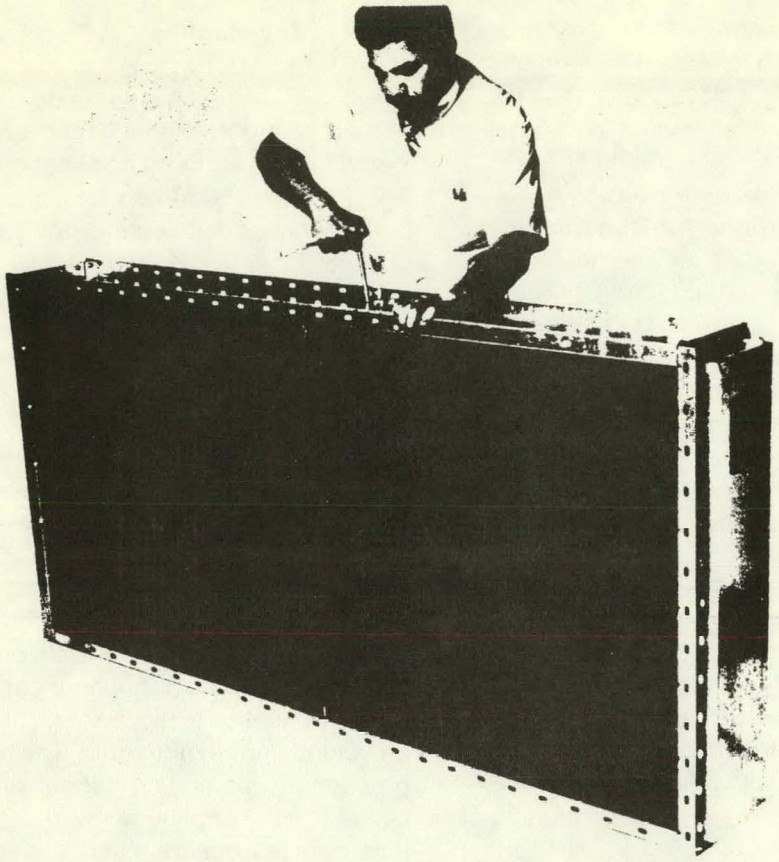
What is a Heat Pipe

The ability of the HeatBank recovery unit to transfer large quantities of heat from one region to another is the result of the design and basic phenomenon of a heat pipe.

The basic heat pipe consists of a closed envelope containing a capillary wick structure and a small amount of vaporizable fluid. The heat pipe employs a boiling-condensing cycle with the continuous working fluid pool returning the condensed fluid back from the cooler end (condenser) to the heat input area (evaporator). The temperature loss between the evaporator and condenser is very small resulting in an almost isothermal process.

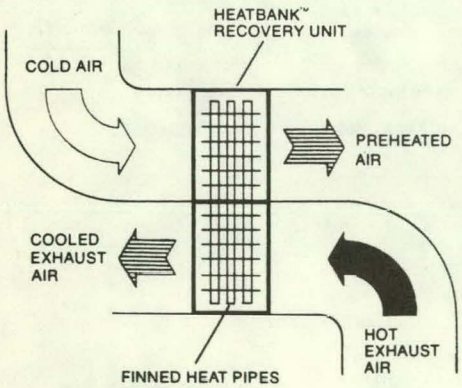


Basic Heat Pipe



Hughes HeatBank™ Heat Pipe Recovery System

By combining a few to several hundred heat pipes with extended area fins into a HeatBank coil, a thermal path is created between two separate counterflow airstreams. This allows large quantities of heat to be transferred from one region to another with low temperature drops, high efficiency, no cross contamination, and with no moving parts or external power requirements.



Counter-Flow Operation

Maximum efficiency is obtained from the HeatBank heat recovery unit when the hot and cold airstreams are next to each other. Since the heat pipe is a continuous vacuum tube, it is not practical, from either a cost standpoint or a heat loss standpoint, to have large separations between the two airstreams.

Although the performance of a heat pipe is enhanced by tilting the unit to aid the gravity return of the working fluid, the pipe can operate in a completely horizontal position. Thus, the pipes in the unit will operate bi-directionally in two-season HVAC applications where only the flow of the warm and cool airstreams change.

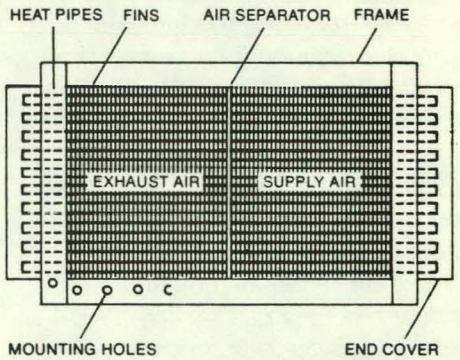
HeatBank™ Features

High Recovery Efficiency
Physical Separation of Airstreams
Compact Size
Lightweight Construction
Low Pressure Drops
Minimum Maintenance
Long Life
No Moving or Load Bearing Parts
No External Power Requirements
Compatible with Standard Dampers and Controls
Simple Ducting Requirements
Wide Range of Unit Sizes and Temperature Ranges
Easily Cleaned

HeatBank™ Models Available

HeatBank units are manufactured to operate within specific temperature ranges for various applications shown in the table.

A variety of materials are used in the construction of the basic components in the HeatBank unit to meet the operational parameters of each application. Standard materials of construction are aluminum for the fins and heat pipes and galvanized steel for the frame, covers and air separator. Copper, carbon and stainless steel are also used for specialized applications. In such applications, the HeatBank unit can also be coated with materials to withstand a variety of atmospheric conditions.



Basic Components of HeatBank™ Unit.

Fin spacing is available from 4 through 14 fins per inch in virtually any number of heat pipe rows deep. Typical efficiencies are in the 60 to 70 percent range with standard pressure drops of 1 inch of water or less.

Models and Temperature Ranges

SERIES MODEL NUMBER	MAXIMUM EXHAUST TEMPERATURE (F)*	SUGGESTED APPLICATIONS
T15	150	comfort-to-comfort
T30	300	moderate temperature process-to-comfort and process-to-process
T40	400	higher temperature process-to-comfort and process-to-process
T50	500	higher temperature process-to-comfort and process-to-process
T60	600	higher temperature process-to-process

*The maximum exhaust temperature rating is based on the highest temperature to which the unit might be subjected. This assures reliability of the unit under a worst-case condition, such as diminished incoming air flow. Under normal operating conditions, the average temperature of the unit will be lower than the maximum exhaust temperature. Higher temperature exhaust can be accommodated under other conditions such as unbalanced airflows or with the use of protection systems.

Comparison to Other Systems

To evaluate the primary types of air-to-air heat recovery systems, their operating characteristics must be compared. In the chart, the operating characteristics of different units are listed and rated. The rating numbers are assigned from 0 to 5 with the higher numbers assigned to the most desirable characteristics. From these ratings and the operating characteristics, we feel that the most attractive is the heat pipe unit. In order to compare these systems, a completely detailed applications analysis must be made.

Comparison of Heat Recovery Units

UNIT TYPE	PRESSURE DROP R_N	HEAT TRANSFER FILM COEFFICIENT R_N	MAINTENANCE EFFORT R_N	COST R_N	AUXILIARY POWER	CROSS CONTAMINATION R_N	TRANSFER AREA PER VOLUME	TOTAL RATING
Regenerators	Mod. 3	High 4	High 2	High 2	Yes	Yes 0	High 4	15
Shell & Tube	High 2	High 4	Mod. 3	Mod. 3	No	No 5	Low 2	19
Plate-fin	Low 4	Mod. 3	Mod. 3	High 2	No	No 5	Very High 5	22
Secondary Fluid	Low 4	Low 2	High 2	High 2	Yes	No 5	Mod. 3	18
Heat Pipe	Low 4	High 4	Very Low 5	Mod. 3	No	No 5	High 4	25

R_N: Relative rating numbers are assigned from 0 to 5.
5 is assigned to the best characteristics and 0 is assigned to unacceptable characteristics.

To Get More Information

This brochure is designed to give you a general idea of when and where to consider heat recovery and how our product might meet your needs.

If you have a specific application and need more information tailored to your requirements, we have provided a return post card for your convenience in requesting such information.

If there is no address label on the card, please complete the address section. Please do not obliterate the label if corrections must be made. Just cross out the information to be corrected and write in new information.

I need more information on your HeatBank unit. Send me literature on:

☐ **industrial heat recovery** ☐ **HVAC heat recovery**

☐ **have an applications engineer contact me. My phone:** _____

My requirement can best be described as: _____

_____

_____

Exhaust temperature range(s): _____ **Exhaust air volume (SCFM):** _____

Contaminents/Particulates _____

I am a: ☐ **consultant** ☐ **contractor** ☐ **packager** ☐ **OEM**

☐ **end user—Please describe type of industry** _____

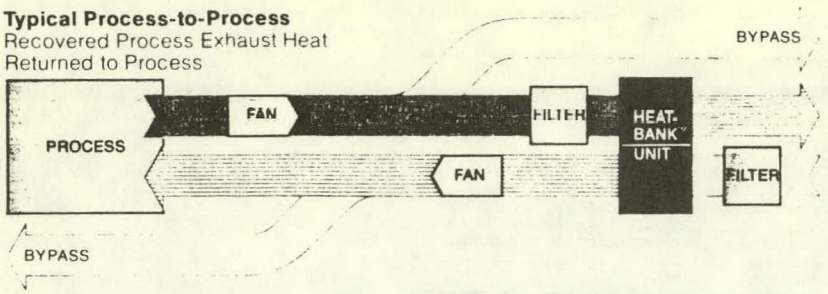
Name 052-08036RKLLIT770303-982-731
RK LITTLE

Company RKL CONTROLS

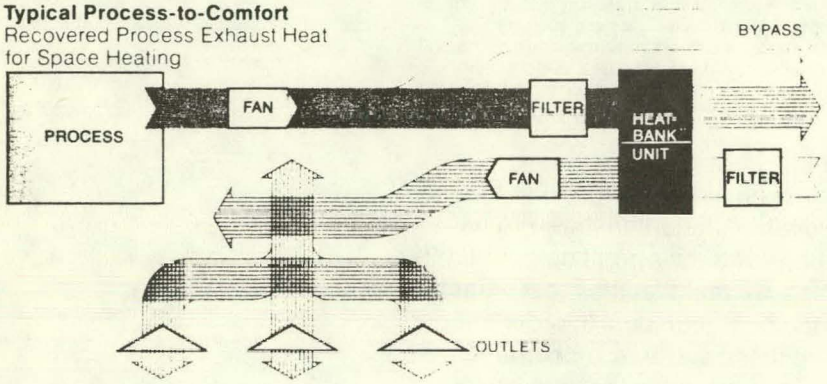
Address HAIMESPORT IND PK

City HAIMESPORT, NJ 08036

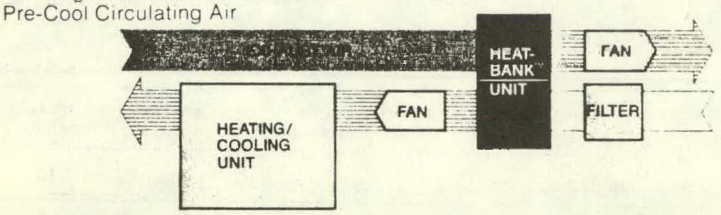
Typical Process-to-Process
Recovered Process Exhaust Heat
Returned to Process



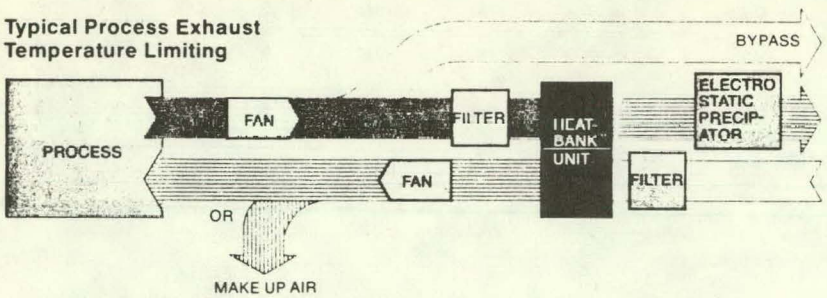
Typical Process-to-Comfort
Recovered Process Exhaust Heat
for Space Heating



Typical Comfort to Comfort
Building Exhaust to Pre-Heat or
Pre-Cool Circulating Air



Typical Process Exhaust
Temperature Limiting



Typical Industrial Applications

Paint Drying Ovens
Food Dryers
Grain Dryers
Pellet Dryers
Plasticizer Curing Ovens
Foundry Furnaces
Print Dryers
Film Dryers
Laundry Dryers
Dehumidifiers
Food Processing Ovens
Boiler Pre-Heaters
Heat Treating Areas
Paper Dryers
Plating Tanks
Tobacco Dryers
Textile Ovens
Chemical Dryers
Laboratory Exhausts
Pollution Control
Paint Spray Booth

Typical HVAC Applications

Apartment Buildings
Banks
Municipal Buildings
Indoor Pools & Rinks
Indoor Tennis Courts
Hospitals
Nursing Homes
Industrial Plants
Research Laboratories
Office Buildings
Schools & Colleges
Sports Complexes
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Restaurants
Dining Halls
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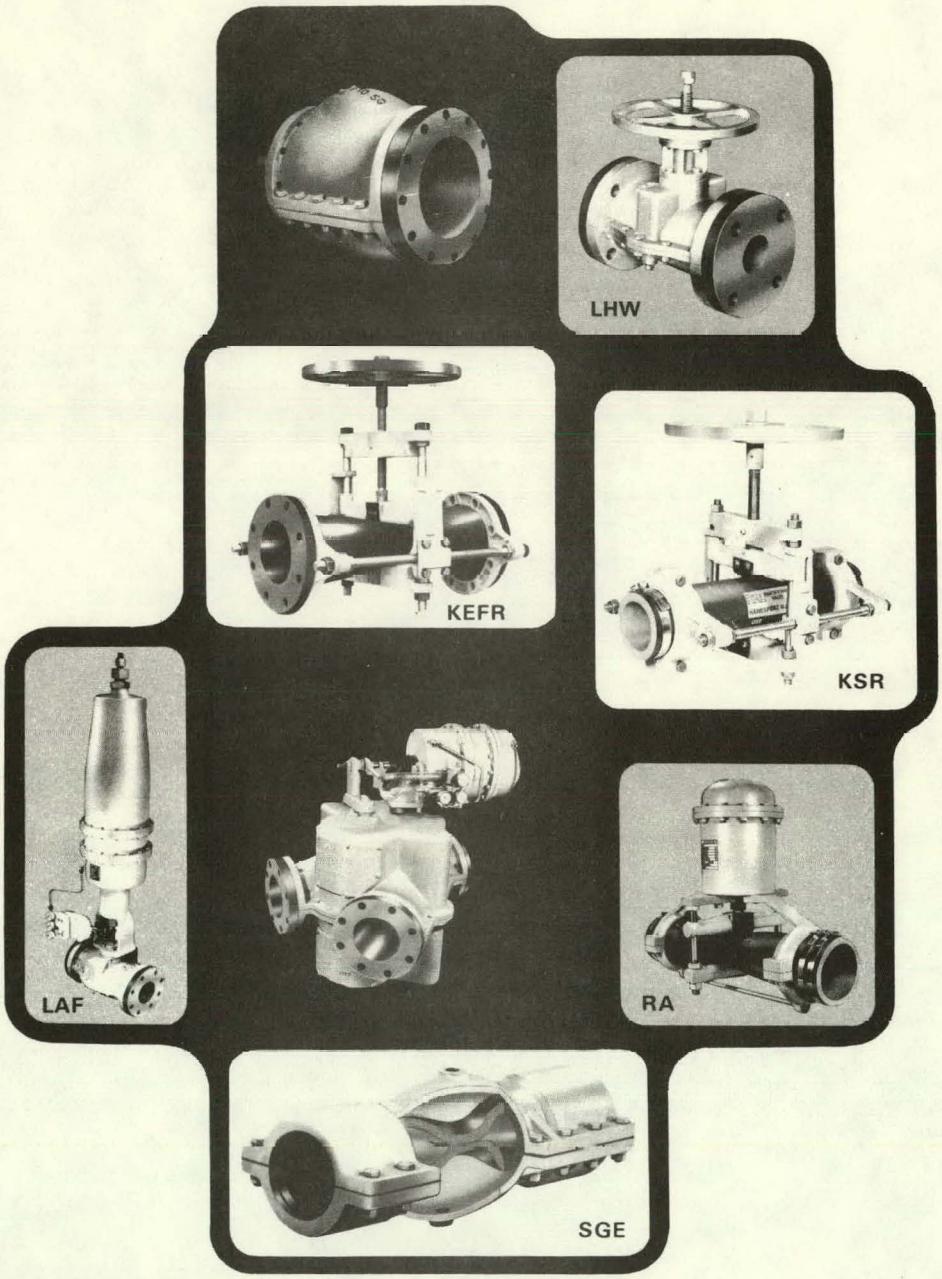
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RKL PINCH VALVES

RKL CONTROLS INC., ARK RD., LUMBERTON, N.J. 08048
Phone (609) 267-2800 • Telex 831-692

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SERIES LHW—BG: Bevel Gear Operated — Totally enclosed elastomer body — Pre-Pinched design
Custom Designs: Oval opening — Chain Wheel Actuators —Infinitely variable orifice valve.

SERIES DV (DIVERTER VALVE): World's only 3-way pinch valve—Totally enclosed elastomer body—Full round opening—On-off or proportional control—Pneumatic, Hydraulic or Electric operators

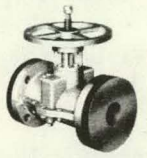
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HOW TO ORDER—OTHER RKL PRODUCTS



L



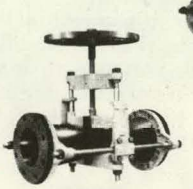
SGE



SG



KSR



KEFR



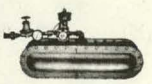
R



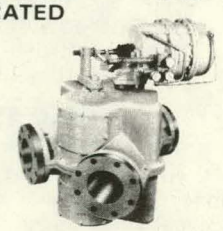
KHL AND KHLF



BEVEL GEAR OPERATED



OVAL



DV (DIVERTER VALVE)

PRINCIPLES OF DESIGN AND OPERATION

superior control performance without maintenance problems

A SIMPLE DESIGN PRINCIPLE SUITABLE FOR 95% OF VALVE APPLICATIONS

The RKL pinch valve operates, as its name implies, on the simple principle of pinching a rubber tube (the body) to effect flow control. Though the principle initially was used to cope with abrasive and corrosive materials, RKL valves are used today in practically every industry. The transformation of the pinch valve from specialized to general-purpose use is predicated primarily upon RKL's success in adapting natural and synthetic rubbers (elastomers) to the rigors of a valve body that must withstand innumerable pinching cycles without cracking. By evolving special compounds and production techniques, RKL has been able to significantly lengthen the service life of a fabric reinforced valve body and, equally important, has been able to develop a diversified line of valve bodies and pinching mechanisms that fit a broad range of application requirements in Chemical, Mining and Process industries. They are also ideally suited for sewage, water treatment and smoke abatement applications.

STRAIGHT-THROUGH FLOW ELIMINATES TURBULENCE, INCREASES CAPACITY

RKL pinch valves have two inherent design advantages over other valve types. They permit straight-through flow in either direction, and they are completely free of any obstructions, moving parts or cavities within the flow pattern that might adversely affect fluid flow or create servicing problems. Together, these two facts are the basis of exceptional, maintenance-free performance.

RKL valves provide absolutely gas-tight and vacuum tight shutoff because there are no seats, discs or packing glands to leak. Also, they exhibit excellent flow characteristics. What's more, the completely unobstructed passage through the body eliminates flow turbulence to the extent that RKL valves have a throttling ratio of 5 to 1. This compares well with the valve norm of 3 to 1. An RKL valve can throttle a flow on 1000 GPM down to 200 GPM without turbulence.

TROUBLE-FREE DESIGN SAFE EVEN FOR SANITARY APPLICATIONS

There is virtually nothing that can go wrong with an RKL valve. It requires no routine lubrication and cannot stick under any conditions. Its simple, straight-through design is completely free of cavities in which entrained solids or contaminating materials can be deposited. Consequently, the RKL valve can handle any material, including slurries and corrosive fluids, within its temperature and pressure limits—without maintenance. It is also used for sanitary service in food and drug processing.

(PRE-PINCHED) AND (FULL ROUND) DESIGN

Since a full round flexible tube doesn't appreciably restrict flow until it is pinched to 50% of closure, RKL originated the PRE-PINCHED design which is able to handle flows within 2% of full pipe capacity. As soon as the upper pinch bar moves from full open towards the closed position, in a Pre-Pinched valve, flow control occurs. Shut-off takes place slightly below the valve's centerline.

In some applications where bridging, high velocities, and particles larger than ½ the pipe diameter occur, a FULL ROUND opening pinch valve is required. The full round valves are available, as are the Pre-Pinched valves, with hand, pneumatic, hydraulic and electric operators in both the open and enclosed construction. However, before flow control occurs, a full round pinch valves must be closed to 50% of the full open position.

LESS EXPENSIVE TO INSTALL, EASIER TO INSPECT

All RKL pinch valves (except the solenoid-operated model) are self-supporting. Those with slip-on connections have enlarged ends that fit over the piping and are held in place with two hose clamps. The valves with flanged connections feature full faced flanges that are an integral part of the rubber body and are backed up by metal flanges. Installation is simple; no floor columns, ceiling hangers, or separate mounting brackets are required. Once installed, the valve is always accessible for normal inspection. Each RKL Valve is fully tested for gas tight closure and control operation under actual specified line pressure conditions, on our test rack, before shipment. Also each valve is fully assembled for immediate installation.

EXCLUSIVE CONSTRUCTION FEATURES:

OVER-PINCHING PROTECTION

Positive stops on all RKL valves prevent the valve body from being pinched beyond the point of gas-tight closure, eliminating unnecessary wear. Stem cover optional.

LARGER BEARINGS

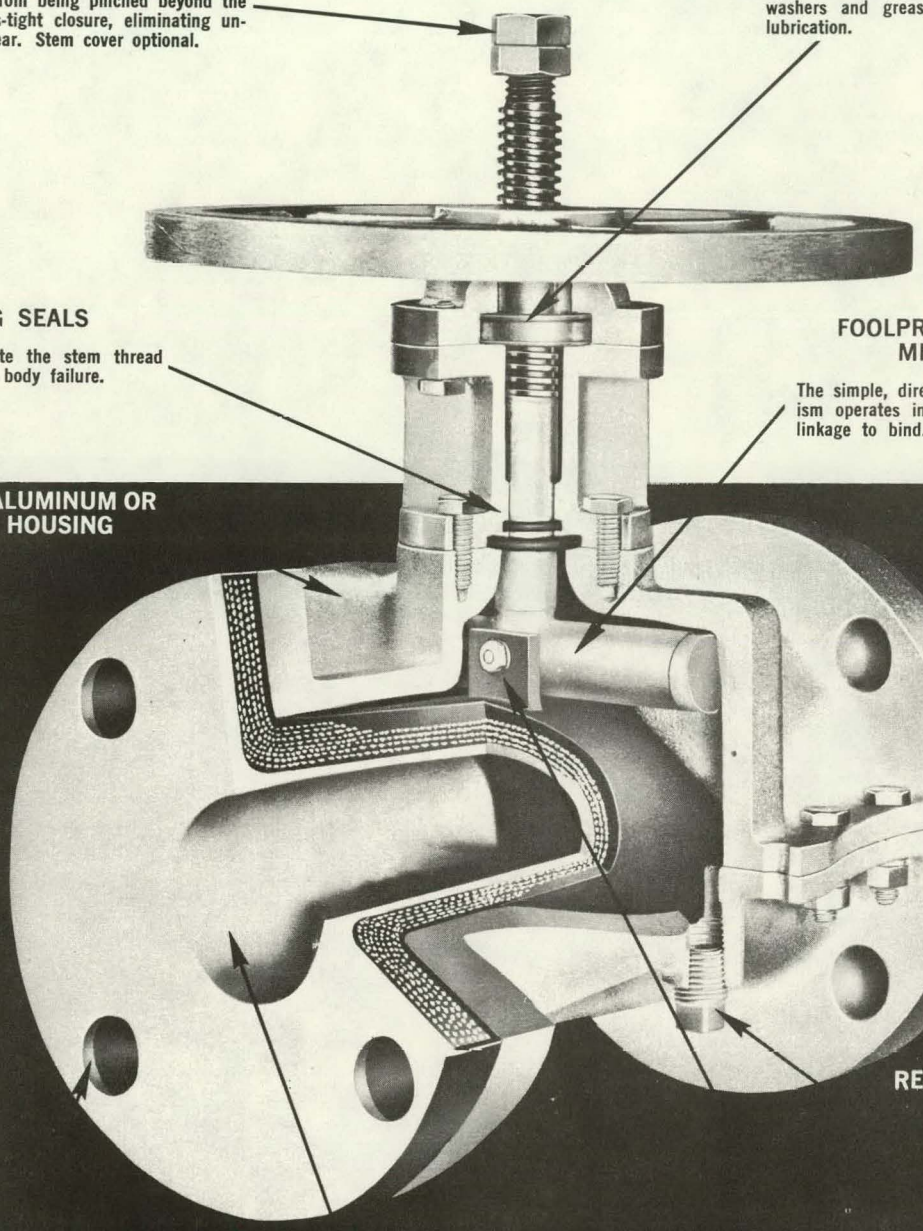
Bearing surfaces are extra large for easy operation. They are equipped with nylon washers and grease fittings for ease of lubrication.

"O" RING SEALS

Seals completely isolate the stem thread mechanism in case of body failure.

FOOLPROOF PINCHING MECHANISM

The simple, direct-acting pinching mechanism operates in any position and has no linkage to bind.



TYPES AND SIZES FOR VARIOUS APPLICATIONS

Industry & Application	Types Used	Size Range
PAPER		
Pulp Stock	SG-L-RAF-KFR	2"-12"
Alum	SG-L-RAF-KSR-Rs	1/2"-6"
Rag Stock	SG-L-RAF-KFR	2"-10"
Bleach Liquor	L-RAF-RA-KFR	1"-12"
Green Liquor	L-RAF-KHL-KFR	1"-12"
Milk of Lime	L-RAF-RA-KFR	1"-8"
White Liquor	L-RAF-KFR-KSR	1"-12"
FOOD		
Vegetable Puree	L-RAF-KSR-KHL	1"-3"
Apple Juice	L-KHL	2"-6"
Pineapple Juice	L-RAF-KFR	1"-6"
Sweet Water	L-RAF	1"-6"
Sugar Pulp	RAF-KFR	2"-8"
Sugar Granules	L-RAF-KHL	4"-10"
Pickle Broth	KSR-RA	2"-4"
Beer	LAF LHW	1" 6"
GLASS		
Sand Slurry	SG-L-RAF-REF-KFR	2"-12"
Ceramic Slip	L-RAF-RA-KFR-KSR	1"-6"
Porcelain Frit	L-RAF-KFR-RA-KSR	1/2"-3"
Grinding Compound	RA-KHL-Rs	1/4"-2"
MISCELLANEOUS		
Cement & Asbestos	RAF-LAF-KFR	4"-8"
Latex	L-RAF-KSR-RA-Rs	1/4"-6"
Carborundum Granules	RAF-RA	2"-6"
Plaster of Paris	SG-L-RAF	1"-3"
Lime Slurry	SG-L-RAF-REF-Rs	1/4"-8"
Sewage Effluent	SG-L-RAF-KFR-REF	2"-16"

Industry & Application	Types Used	Size Range
MINING		
Taconite Slurry	SG-L-KFR-REF	1"-16"
Sand & Water	SG-L-KFR-RAF	3/4"-10"
Coal Fines & Water	SG-L-KFR-RAF	2"-14"
Dusty Air	SG-RAF-KHL	1/4"-12"
Acid Leach Solution	L-KFR-Rs	1/4"-14"
Flotation Media	SG-KSR-KFR-RAF	1"-8"
Acid Mine Water	L-KFR-RAF-KSR	1"-10"
Phosphate Slurry	L-KFR-RAF	1½"-16"
Cement Slurry	SG-LAF-LEF-LHW	4"-12"
Potash Slurry	SG-L-KFR-RAF	2"-18"
Clay Slurry	SG-L-KFR-RA	1"-6"
Titanium Oxide	L-RAF-KFR-Rs	1"-8"
Ilmenite	L-KFR-RAF-KSR	2"-14"
Copper Ore Slurry	SG-L-KFR-REF	2"-18"
Lead Ore Slurry	SG-L-KFR-KSR	1"-8"
Nickel Ore Slurry	KFR-L-KHLF	1"-10"
Uranium Ore Slurry	L-KFR-RAF-KSR	1"-14"
CHEMICAL		
Benzene & HCL	KFR-RAF-LAF	4"-8"
Detergents	LHW-LAF	3/4 -4
Salt Water	L-KFR-RAF	1"-12"
Catalysis Granules	SG-L-RAF	2"-8"
P.V.C. Granules	SG-RA-KSR	1½"-6"
Nitroglycerin	RA-KHL-KSR	1"-4"
Explosive Powders	SG-L-KFR-KSR	1/2"-10"
Carbonates & Water	SG-L-KFR-KSR	1/2"-8"
Sodium Silicate	SG-L-RAF	1/2"-8"
Carbon Powder	SG-RAF-KSR-KHLF	1"-10"
Salt Cake	SG-KFR-RAF	2"-8"
Distilled Water	KFR-KSR-RA-KHL	1/2"-4"
Magnesium Slurry	SG-KFR-RAF-L	1/2"-6"
Acids (all types)	L-KFR-RAF-KHL-Rs	1/4"-12"

ELASTOMERIC BODIES

A CHOICE OF BODIES TO MEET ANY OPERATING CONDITIONS

RKL has developed, over the last 15 years, special low durometer, high tensil, elastomeric compounds to meet the demanding corrosion and abrasion resistance required for long life in pinch valve bodies.

The formulation of these compounds varies depending on the application. However, the general characteristics of the elastomer are shown.

Any elastomer not listed may be had on special application.

COMPOUNDS	CHARACTERISTICS
P.G.R.	Excellent Corrosion & Abrasion Resistance
G.R.S.	Excellent Combination of Abrasion & Temperature Resistance
BUNA-N	Good Solvent and Hydrocarbon Resistance
NEOPRENE*	Good Chemical and Hydrocarbon Resistance
NEOPRENE* (O&T)	White Compound with Food Chemical and Abrasion Resistance
BUTYL	Good Combination of Chemical & Temperature Resistance
BUTYL (O&T)	White Compound with Good Animal & Vegetable Oil Resistance
HYPALON*	Excellent Chemical & Temperature Resistance
P.G.R. (CONDUCTIVE)	Good Dry Abrasion Resistance at High Velocities
VITON*	Outstanding Chemical & Temperature Resistance
SILICONE	Good Combination of High & Low Temperature Resistance
EPDM	Excellent Heat & Chemical Resistance
FDA RUBBER	Food & Drug applications with excellent abrasion resistance.
POLYURETHANE	Excellent Abrasion & Hydrocarbon Resistance

Note: (O&T) = Odorless and Tasteless

*DuPONT TRADEMARKS

BODY CONSTRUCTION FEATURES:

Only a GENUINE RKL pinch valve body is fully molded from flange to flange or connection to connection in all sizes thru 24 inches. RKL is the only manufacturer to fully mold its fabric reinforced pinch valve bodies using special compounds made to their exacting specifications for high corrosion and abrasion resistance. The molding operation means no delamination such as occurs in hand wrapped bodies, and consequently longer life expectancy. The specially woven fabric reinforcement is plyed into the construction in such a way that the body has high flexibility and exceptionally high burst strength. Each flange is tapered for a tighter seal against high line pressures. They are drilled to either 150# or 300# ANSI flange standards and being full faced offer the best possible seal against leakage at the flanges. The fully patented positive opening feature is molded into the body as separate tabs from the reinforcing fabric. No metal inserts are used and the flexibility of these tabs does not hinder the gas tight seal upon closure.

ENCLOSED PRE-PINCHED MECHANISM TYPES

HANDWHEEL - PNEUMATIC - HYDRAULIC - AND

FOR THE ULTIMATE IN FLOW CONTROL

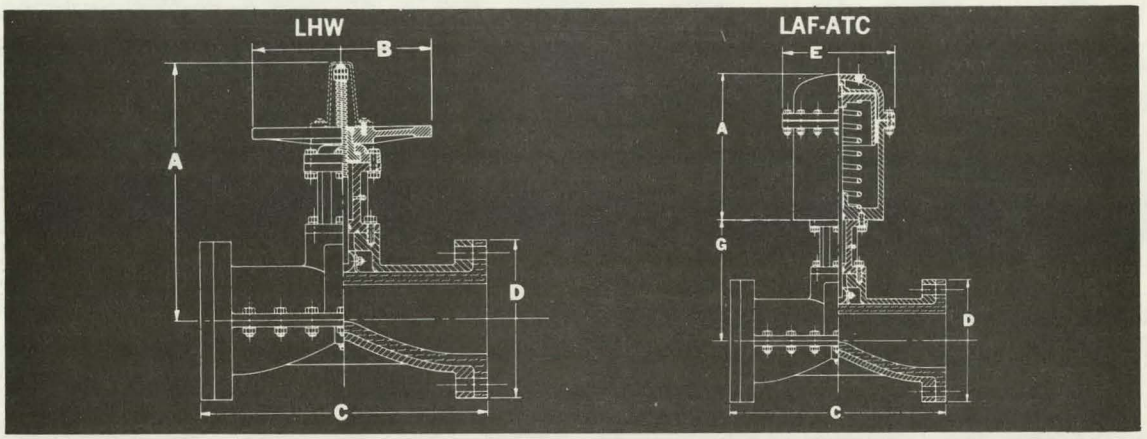
The RKL Series L pinch valve is unsurpassed for repeatable process control from computer programs, instrument air signals or milliamp electric signals.

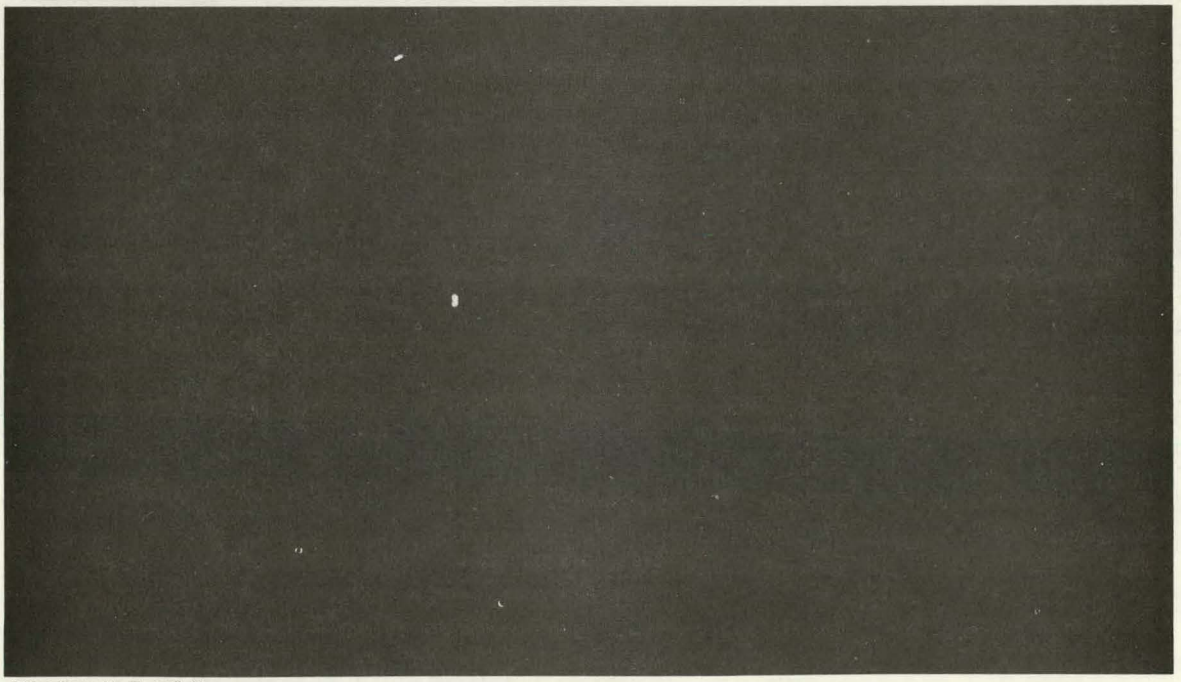
The fully enclosed, fully self supported housing, offers maximum protection in highly corrosive atmospheres and from possible elastomer body rupture. It also can be specified for vacuum service so that a dead end vacuum may be applied between the housing and the elastomeric body to equalize a vacuum pressure within the pinch valve body. This allows the series "L" pinch valve to be used on any vacuum application.

By specifying the correct elastomeric body this series can be used on abrasive or corrosive service within a pressure range of 10^{-10} vacuum to 300 psig and a temperature range of —100°F to 550°F, depending on application.

The full faced tapered elastomer flanges offer the most positive flange sealing available and the exclusive fully molded fabric reinforced body construction means no problems with replacement bodies not fitting and no delamination of the pinch valve body tube. When the fully patented positive opening feature is used there is no need to rotate the pinch valve body to prevent it from taking a permanent set.

All series "L" actuators are totally enclosed for use in dusty atmospheres or exposure to the elements. They are of the non-rising actuator type so that they can be piped for air operation or wired for electric operation without the use of flexible air hoses or flexible conduit. The various types of actuators are shown opposite on page 7. • Sizes larger than 14 inch are available on application.

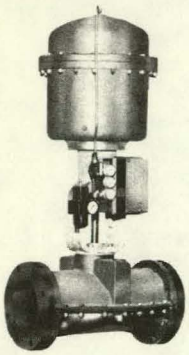




**Availbale Up To 24" Size
H.W.—Handwheel Operated
ATCP—Air-To-Close With Positioner
ATC—Air-To-Close (open on air failure)
ATOP—Air-To-Open With Positioner
ATO—Air-To-Open (close on air failure)
ATOSP—Air-To-Open, Spring-To-Close
LEF—Electrically Operated
ADA—Air-To-Open, Air-To-Close

*ALSO AVAILABLE WITH CHAIN WHEEL OPERATOR (SEE PAGE 15)

ELECTRICALLY OPERATED VALVES *SERIES "L" for all pressure*

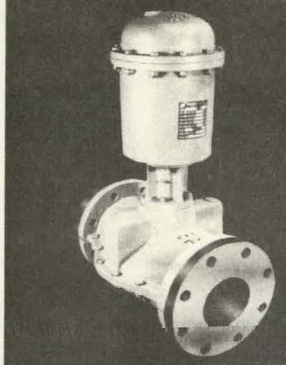


Open Stem Yoke Construction

The open stem yoke design on our "L" series pinch valve is used to mount indicating switches, stem indicator, auxiliary manual handwheel and various makes of side mounted positioners, e.g. Bailey, Fisher, Hammel Dahl, Honeywell, Masoneilan, Moore and Taylor.

LAF ATC-P W/BAILEY AP 2

See Bulletin # 477

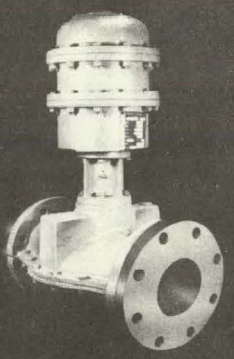




Air-to-Open, *Fail Closed

This long stroke, patented, trapped air rolling diaphragm actuator, (Rollomotor) has a small diameter for use on air pressures up to 125 psig. It will not drift open after prolonged air failure. Furnished with two gauges, PRV and check valve, as standard. No external air tank required. It can be specified for hydraulic actuator to open with trapped air to close.

LAF-ATO

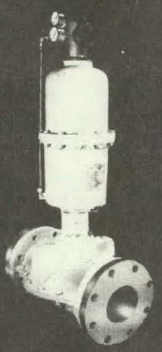




Air-to-Close, Fail-Open, with Positioner

By combining the standard air-to-close actuator (Rollomotor) with an integrally mounted positioner, a simple but precise, totally enclosed, instrument air proportioning valve actuator, with feed back to the positioner, is achieved. Any make of side mounted positioner can be furnished with an open yoke construction as shown above.

LAF-ATCP



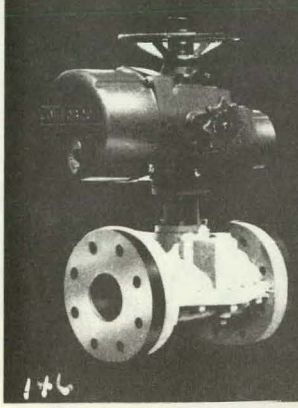


Air-to-Open, Spring-to-Close

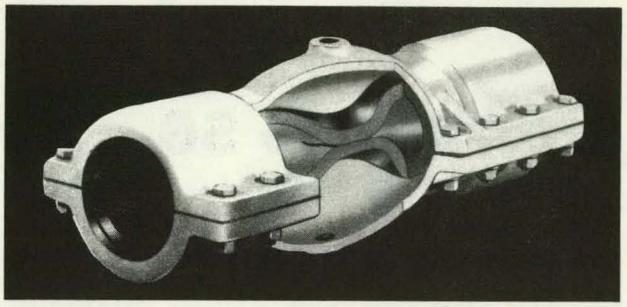
This exclusive rolling diaphragm actuator (Rollomotor) is the only one available to industry to operate a pinch type valve. It is primarily for on-off service and offers the most positive fail-closed action available. Any make of side mounted positioner can be furnished with an open yoke construction as shown above.

LAF-ATOSP

Patented



Slip-on Connections—Pneumatically or Hydraulically Operated—Totally Enclosed—No Moving Parts—Full Range of Elastomers for Abrasive or Corrosive Applications



SERIES SGE

The SGE valve is the simplest and consequently the lowest cost remotely operated pinch valve available to industry.

OPERATION: Operation of the SGE valve is by application of hydraulic or pneumatic pressure through the pipe connection in the housing to the annular volume surrounding the elastomeric tube. As pressure is applied the central portion of the tube collapses from opposite sides effecting centered, straight-line closure. Only straight-line closure can provide gas-tight closure on slurries, gases and liquids. Upon reduction of applied pressure to atmosphere (or to vacuum if line pressure is a vacuum), the elasticity of the liner opens the valve to full-round configuration. If a vacuum condition exists in the flow-line, a vacuum source, such as a vacuum generator, may be applied to the operating line to fully open the valve.
The SGE valve is generally specified for on-off service, but approximate flow control (throttling) can be effected by using a PRV (pressure reducing valve) to vary the operating pneumatic or hydraulic pressure.
To insure maximum cycle life, a PRV should be installed and set no higher than is necessary to close the valve tight.

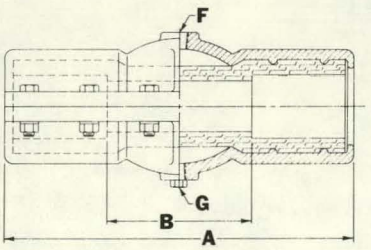
CONSTRUCTION: The SGE pinch valve is constructed with a split housing for easy change of elastomeric bodies, meaning less down-time for maintenance. Standard housing is cast aluminum, but cast-iron is available upon request. Body construction is tailored to operating conditions, and bodies are available in a wide range of elastomers including: pure gum rubber, (natural rubber), Neoprene, Buna N, Butyl, Hypalon†, Silicone, Viton†, EPDM (Nordel†) and food grade elastomers. Other elastomers available upon application.

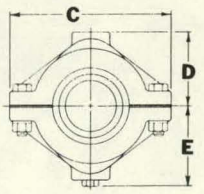
MAINTENANCE: No maintenance or cleaning is necessary for the life of the valve, since there are no moving parts, no packing glands, and no seals. Length of service of the elastomeric body is dependent upon the material handled, line and operating pressures, frequency of cycling, and other factors.

APPLICATIONS: The SGE pinch valve is being successfully employed in air and vacuum veying systems, handling dry powders as well as a wide range of slurries and for controlling pump discharge and hopper unloading. It can be employed in almost any aspect of pollution abatement due to its ability to close bubble tight over solid particles.

OPTIONAL ACCESSORIES: PRV (Pressure Reducing Valve), 3-Way Solenoid Valve, Air Pressure Gauge (Specify if installation and adjustment is desired).

NOTE: Air supply should be approximately 40 psig higher than line pressure in order to insure full closure of valve.



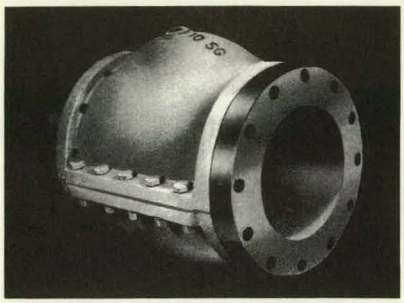


†E. I. duPont Co. trademarks

SERIES SGE DIMENSIONS										
VALVE SIZE	1/4	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
A. LENGTH	4-1/4	5-3/8	6-1/8	7-3/16	8-1/2	10-1/4	11-3/4	14-1/4	16-1/4	20-1/4
B. BETWEEN PIPE	1-5/8	2	2-1/2	3	3-1/2	4-1/4	5-1/2	7	8	10
C. WIDTH	2-7/8	3-1/4	3-1/2	4-1/8	4-1/2	4-3/4	5-3/8	6-5/8	7-1/2	8-3/4
D.	1-1/16	1-1/4	1-7/16	1-11/16	2	2-3/16	2-5/8	3-3/16	3-5/8	4-5/8
E.	1-3/8	1-9/16	1-3/4	2	2-5/16	2-1/2	2-15/16	3-1/2	4	5
F. NPT (SUPPLY)	1/8	1/8	1/8	1/4	1/4	1/4	1/4	1/4	1/4	1/4
G. NPT (DRAIN)	1/8	1/8	1/8	1/4	1/4	1/4	1/4	1/4	1/4	1/4
WEIGHT (ALUM.)	1½	1¾	3	4½	5½	7½	10	21	24	38
WEIGHT (C.I.)	3	4	6½	10	12	17	22	46	53	84

MAXIMUM PRESSURE 1/4" – 2" 50 PSIG, 3" – 4" 35 PSIG. HIGHER PRESSURE ON APPLICATION

Flanged Connections—Short Length—Cast Iron or Aluminum Housing—Pneumatically or Hydraulically Operated—Totally Enclosed—No Moving Parts—Natural or Synthetic Rubber Body



SERIES SG*

Simplicity makes the SG series pinch valve the lowest cost totally enclosed pinch valve with flanged connections available to industry.

OPERATION: The series SG pinch valve operates on the same principle as the SGE valve found on page 8. The SG series valve is also employed primarily in on-off service, but is capable of approximate flow control by variance of operating pressure. In all sizes and at all pressures, gas-tight closure occurs in a straight line, not a three-lobe configuration.

CONSTRUCTION: The SG series valve differs from the SGE series only in that the elastomeric body is constructed with integrally molded 125/150 pound ANSI tapered, full-faced flanges and the housing is drilled and tapped accordingly. As with all RKL valves, the SG series valve is tailored to operating conditions in body construction and selection of elastomer. Housing is available in cast-iron or aluminum. Sizes up to 24 inches.

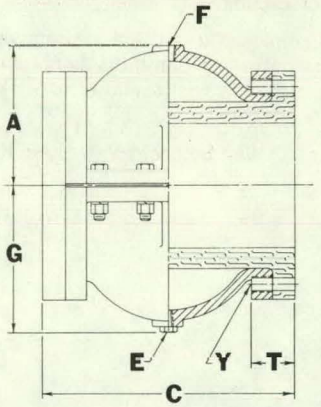
MAINTENANCE: As with the SGE series, absolutely no maintenance is required for the life of the valve. The split-housing construction allows simple and rapid replacement of the low cost elastomeric body. With no moving parts, the housing will last indefinitely.

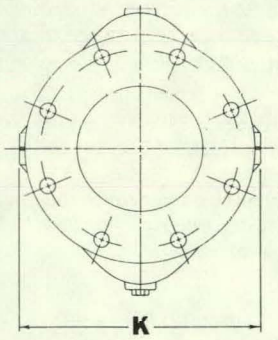
APPLICATIONS: SG pinch valves are used in any type of on off service, particularly where abrasion or corrosion are significant factors and where extended cycle life is not of primary importance.

OPTIONAL ACCESSORIES: PRV (Pressure Reducing Valve), 3-way Solenoid Valve, Air Pressure Gauge (Specify if installation and adjustment is desired.

NOTE: AIR SUPPLY SHOULD BE APPROXIMATELY 40 PSIG HIGHER THAN LINE PRESSURE IN ORDER TO INSURE FULL CLOSURE OF THE VALVE.

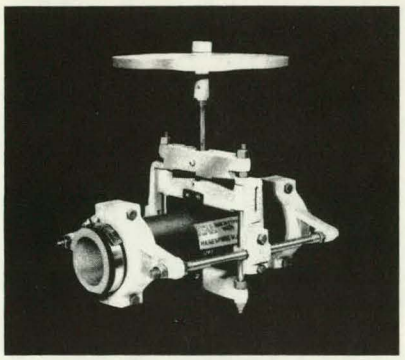
*Patented





SG DIMENSIONS															
VALVE SIZE	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18
C: INSTALLED LENGTH	4	4-5/16	4-3/4	5-1/4	5-3/4	6	8	10	12	16	20	24	28	32	36
A: CENTERLINE TO TOP	2-3/4	2-5/8	3-1/4	3-1/4	3-3/4	4-1/4	5	5-7/8	7	8-3/4	10-1/2	11-3/4	13-5/8	15-1/4	16-3/8
G: CENTERLINE TO BOTTOM	3	2-7/8	3-1/2	3-1/2	3-1/2	4-1/2	5-1/4	6-1/8	7-1/4	9	10-3/4	12	13-7/8	15-1/2	16-5/8
F: AIR CONNECT. NPT	1/4	1/4	1/4	1/4	1/4	1/4	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	1
E: DRAIN CONNECT. NPT	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
WEIGHT CAST IRON (APPROX. LBS.)	6	9	10	15	24	25	48	63	85	171	340	433	587	941	1000
WEIGHT ALUMINUM (APPROX. LBS.)	3	4	5	8	11	13	25	42	50	89	142	190			
MAX. WORKING PRESSURE PSIG	75	75	75	75	75	75	50	50	50	50	50	50	50	50	25
Y: BOLT THREAD (N.C.)	1/2-13	1/2-13	1/2-13	5/8-11	5/8-11	5/8-11	5/8-11	3/4-10	3/4-10	3/4-10	7/8-9	7/8-9	1-8	1-8	1-1/8-7
T: TOTAL FLANGE THICKNESS	1	1-1/8	1-1/8	1-1/4	1-1/4	1-1/2	1-3/4	2	2-1/8	2-3/8	2-5/8	2-3/4	3-3/8	3-1/2	3-5/8
K: WIDTH	4-1/4	5-1/4	5-1/8	6-1/4	7	7-1/8	9-3/4	11	11-1/2	14-1/2	17	20	22-1/2	24	26-1/2

Handwheel Operated*—Open Construction—Enlarged Ends (Slip-on) Connections—Full Round Configuration—Indicating Limit Switches (Optional)



SERIES KSR

The KSR series is the only line of handwheel operated, open construction pinch valves with enlarged ends (slip-on) for installation on schedule 40 pipe, available in sizes ¼" thru 8".

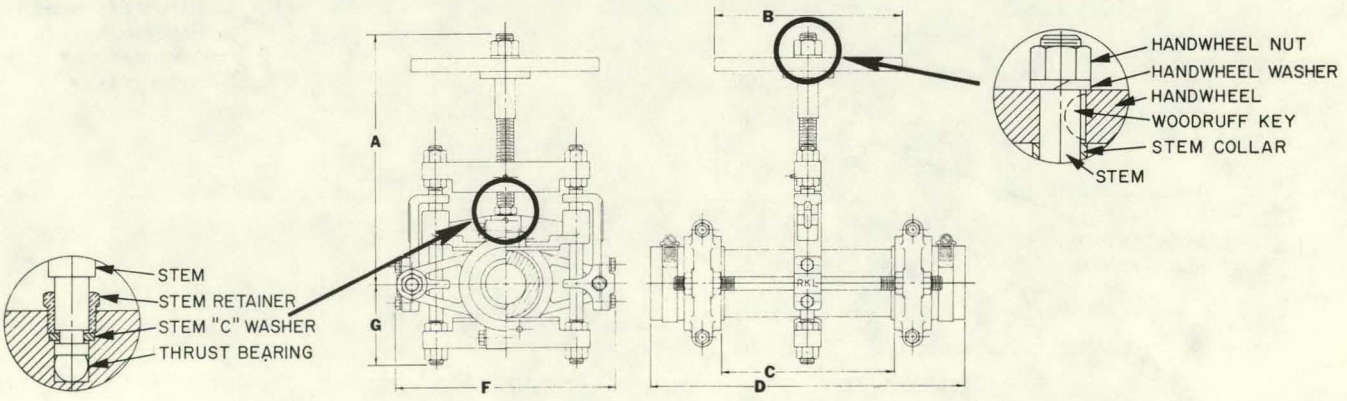
OPERATION: The KSR series pinch valve is operated by a handwheel which acts directly on a free floating dual pinch bar mechanism to close or open the elastomeric body. The free floating mechanism allows even closure from both sides and the patented positive opening feature (optional) insures even and complete opening since the rubber body is attached directly to the pinch bars. Closure is bubble tight and opening is full round. Over-pinching of the rubber body is prevented by the positive closure stop on the stem.

CONSTRUCTION: All cast parts of the KSR pinch valve mechanism are of cast iron material. Stem and guide rods are 303 Stainless Steel and tie rods are cold-rolled stainless steel. Mechanism is enamel painted to resist corrosion. For use in extremely corrosive atmospheres, mechanism can be epoxy coated for a small additional charge. The rubber body is available in all known elastomers to insure maximum possible life in any combination of abrasive or corrosive applications. Fully molding every body insures excellent compaction of the material and absolute uniformity in wall thickness for perfect closure. Installation of the valve is simply a matter of loosening the clamps at either end and slipping the rubber body of the valve over clean unthreaded schedule 40 pipe.

MAINTENANCE: Other than lubrication of the operator stem, no maintenance is required. The KSR valves are capable of extremely long cycle life, but when the rubber body finally fails, replacement is simple and inexpensive.

APPLICATIONS: The KSR series pinch valves are used in any number of abrasive and corrosive applications where manual control is desirable and where extremely long, trouble-free life is necessary.

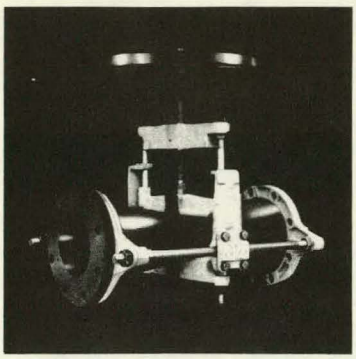
***ALSO AVAILABLE WITH CHAIN WHEEL OPERATOR (SEE PAGE 15)**



VALVE SIZE	¼	½	¾	1	1¼	1½	2	2½	3	4	5	6	8
DIMEN: A CLEARANCE	7¼	7½	8	8	9¼	9½	10¼	11¼	12¼	16	19½	21	27
DIMEN: B	6	6	6	6	7	7	7¾	10	10	12	14	16	20
DIMEN: C BETWEEN PIPE	1-5/8	2	3	4	5	6	8	10	12	16	15	18	24
DIMEN: D LENGTH	4¾	5	6	7½	9½	11¾	14	16	18¾	25½	23½	27½	34½
DIMEN: F WIDTH	6½	6½	6½	6½	8½	8½	9	10	11	14	17	18	23
DIMEN: G CLEARANCE	2	2¼	2¼	2½	3	3¼	3½	4¼	4½	6	7	8	9¼
MAX. WORKING PRESS. (PSIG)	150	125	125	125	125	125	125	125	100	75	75	50	50
WEIGHT	7	7	7	9	14	18	25	27	41	75	115	147	290

ALL DIMENSIONS IN INCHES

Handwheel Operated*—Open Construction—125/150 pound ANSI Flange Connections —Full Round Configuration—Indicating Limit Switches (Optional)



SERIES KEFR

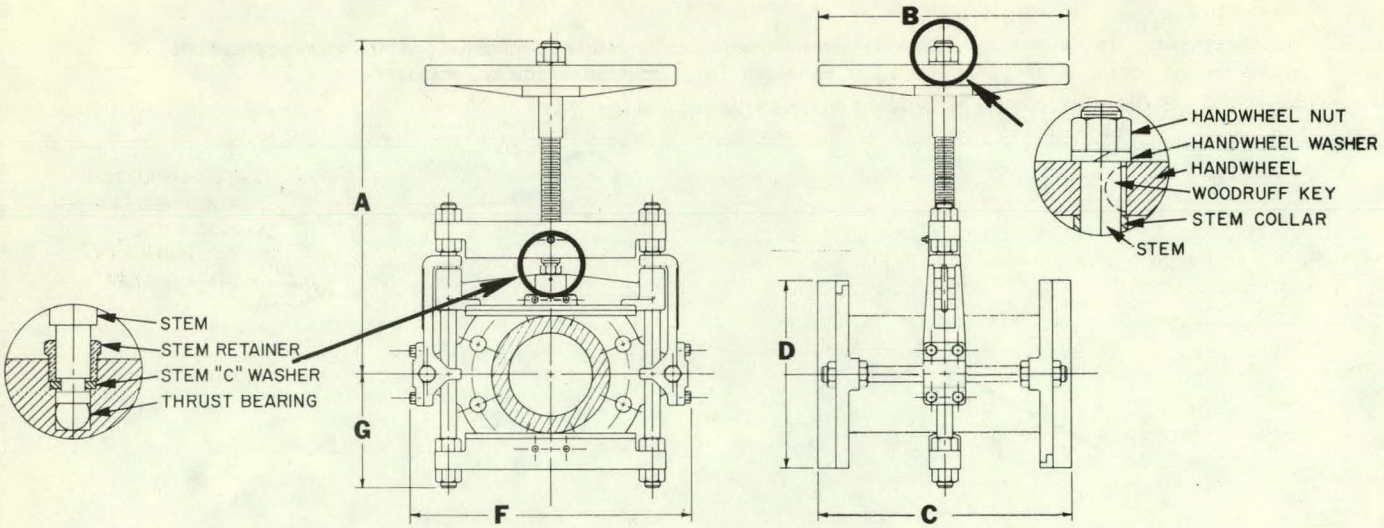
The KEFR series is the only line of full round opening pinch valves with flanged connections available to industry in sizes from 1" thru 18".

OPERATION: The KEFR series mechanism is identical to the mechanism of the KSR series valves shown on page 10. Therefore, the KEFR series has all the advantageous operating features of the KSR series. The handwheel operator works easily for flow control or closure with no levers or brute force required. In larger sizes and at higher working pressures, a hand-operated hydraulic actuator is provided as standard equipment.

MAINTENANCE: Handwheel stem lubrication is the only maintenance required for the life of the valve. As with all RKL pinch valves, no cleaning is necessary. When the elastomeric body wears out, replacement is simple and inexpensive. Extremely long cycle life is characteristic of the KEFR rubber valve body.

APPLICATIONS: The KEFR series pinch valves are used in any number of abrasive and corrosive applications where manual control is desirable and where extremely long, trouble-free life is necessary.

***ALSO AVAILABLE WITH CHAIN WHEEL OPERATOR (SEE PAGE 15)**



VALVE SIZE	1	1½	2	2½	3	4	5	6	*8	*10	*12	*14	*16	*18
Dimen: A Clearance	8	9½	10¼	11¼	12¼	16	19½	21	27	32	37½	41	46	53
Dimen: B	6	7	7	10	10	12	14	16	20	24	24	28	32	40
Dimen: C Installed	4 & 6	6	8	10	12	16	15 & 20	18 & 24	24 & 32	30 & 40	36 & 48	42	48	54
Dimen: D	4¼	5	6	7	7½	9	10	11	13½	16	19	21	23½	25
Dimen: F	6½	8½	9	10	11=	14	17	18	23	27½	32	35½	42	48
Dimen: G Clearance	2½	3¼	3½	4¼	4½	6	7	8	9¼	10½	13	14	16½	18
Max. Working Press. (PSIG)	150	150	150	150	150	100	100	100	100	50	50	50	50	50
Weight	10	18	20	33	35	71	100	130	180	305	415	540	1133	1750

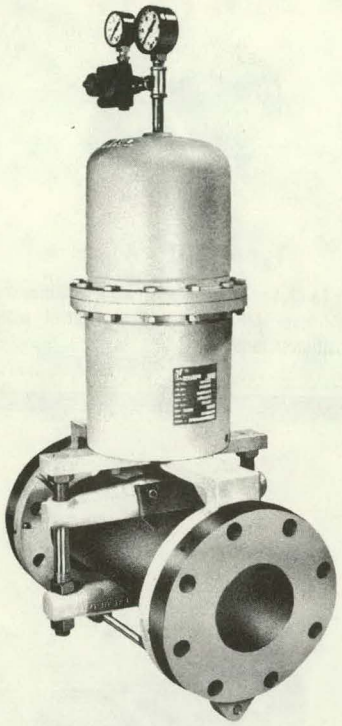
All dimensions in inches

*Available with Bevel Gear Operator

OPEN MECHANISM TYPES

AIR AND ELECTRICALLY-OPERATED VALVES

SERIES "R" for automatic control on 125/150# ANSI flanged-or non-flanged-pipe systems



ATO* AIR-TO-OPEN FAIL CLOSED

THE ULTIMATE IN OPEN CONSTRUCTION PINCH VALVES

The series "R" line consists of two basic types. The flange type "RAF" and the enlarged end type "RA". Both types have open mechanisms for use where the totally enclosed series "L" is not required. They are available with all types of pneumatic or electric actuators for on-off, proportioning, floating, fail-open or fail-closed action as shown opposite on page 11.

These valves are available with aluminum and steel or cast iron and steel mechanisms. They are completely self supporting, when installed, with flow in either direction and may be mounted in any position without having to purchase special support brackets for various attitudes.

The RAF series has 125/150 pound ANSI standard flanges. As with all flanged RKL valves, the flanges of the RAF series are fully molded as an integral part of the elastomeric body (or sleeve) of the valve and have a 2° taper to improve sealing characteristics through additional compression at the inside edge. High pressure molding during vulcanization gives RKL pinch valve bodies their established reputation for quality, uniformity, and exceptional durability. RKL's patented positive opening feature is available on all series "R" valves.

The enlarged end "RA" body is of the same high quality fully molded construction and is for use on unthreaded schedule 40 pipe.

The pre-pinched design, originally developed by RKL, offers capacities within 2% of full round opening valves. Flow is streamlined across the pre-pinch and no lost motion is involved for proportioning flow control as explained on page 2 under "Pre-Pinched and Full Round Types".

All pneumatic actuators are RKL Rollomotors. These rolling diaphragm actuators have the advantages of long stroke, high pneumatic working pressures for tremendous thrust, and maximum efficiency through direct actuation. These compact units provide space economy as well as monetary savings to the user. Other types and makes of actuators available upon application.

SERIES RA VALVE

SERIES RAF VALVE

ACTUATOR DIMENSION (Air Operated)

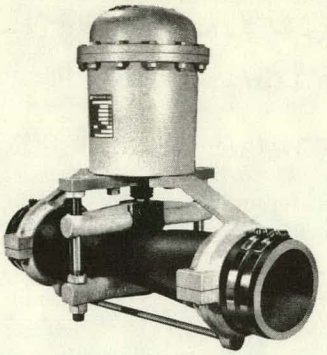
ELEC. OPERATOR DIMEN.

ATC—Air-To-Close (Open on air Failure)
ATO—Air-To-Open (Close on air Failure)
ATOSP—Air-To-Open, Spring-To-Close

ATCP—Air-To-Close with Positioner
ATOP—Air-To-Open with Positioner
REF—Electrically Operated

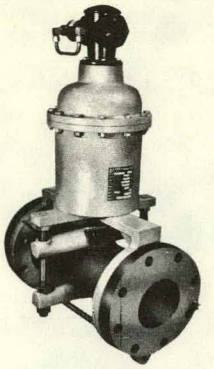
ADA—Double Acting

***PATENTED**



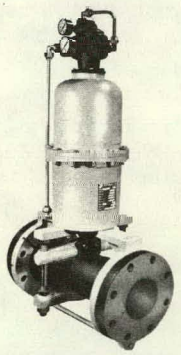
Type RA - ATC

Air-to-Close, Fail Open. Ideal for simple low cost in line applications. For on-off service and pressures to 100 psig.



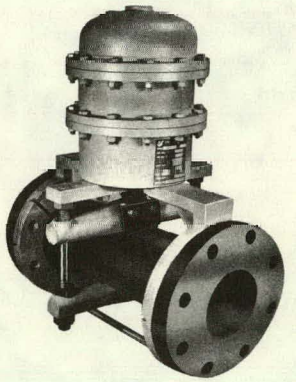
Type RAF - ATCP

Air-to-Close, Fail Open with Positioner. Low cost proportional flow control with positioner feedback.



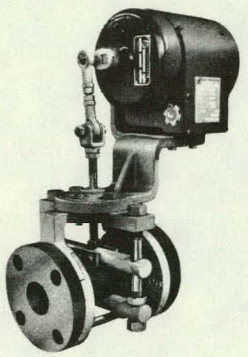
Type RAF - ATOP*

Air-to-Open, - Fail Closed with Positioner. For proportional flow control, no external tanks needed.



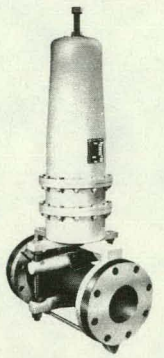
Type RAF-ADA

Air-to-Open, Air-to-Close, Double Acting. For fail in last position.



Type REF

Electrically Operated. Fail in Last Position. For on-off, floating, or proportioning control with slidewire, 110-220 or 440 volts 60 cycles.



Type RAF - ATOSP

Air-to-Open, Spring-to-Close. The most positive fail closed action. Available with side mounted positioner for flow proportioning, or special dribble control.

*Patented

OPEN MECHANISM TYPES

HAND LEVER OPERATED VALVES

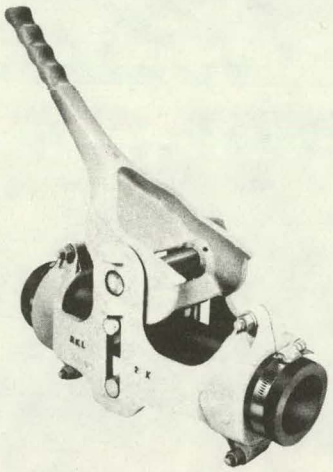
SERIES K for quick-acting "on-off" service or manual flow control*

The exclusive, fully patented, hand lever operated series K valves offer the only quick acting manually operated pinch valve available to industry. The self locking cam lever passes beyond the center in the closed position so that the valve will not fly open when pressurized in this position. These valves are primarily for on-off service. However, special flow adjusting screws, located on either side of the valve, can be furnished on application to limit the valve opening so that it can always be opened to the same predetermined flow rate.

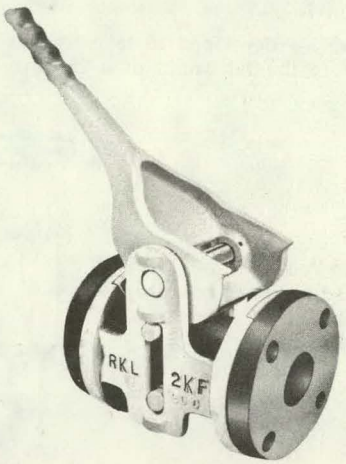
The type "KHLF" is for flanged pipe systems and is drilled to 125/150# ANSI standards.

The type "KHL" is for use with schedule 40 pipe systems and is installed simply by loosening the hose clamps and clamping bolts at each end and inserting plain unthreaded pipe and then retightening the bolts and hose clamps.

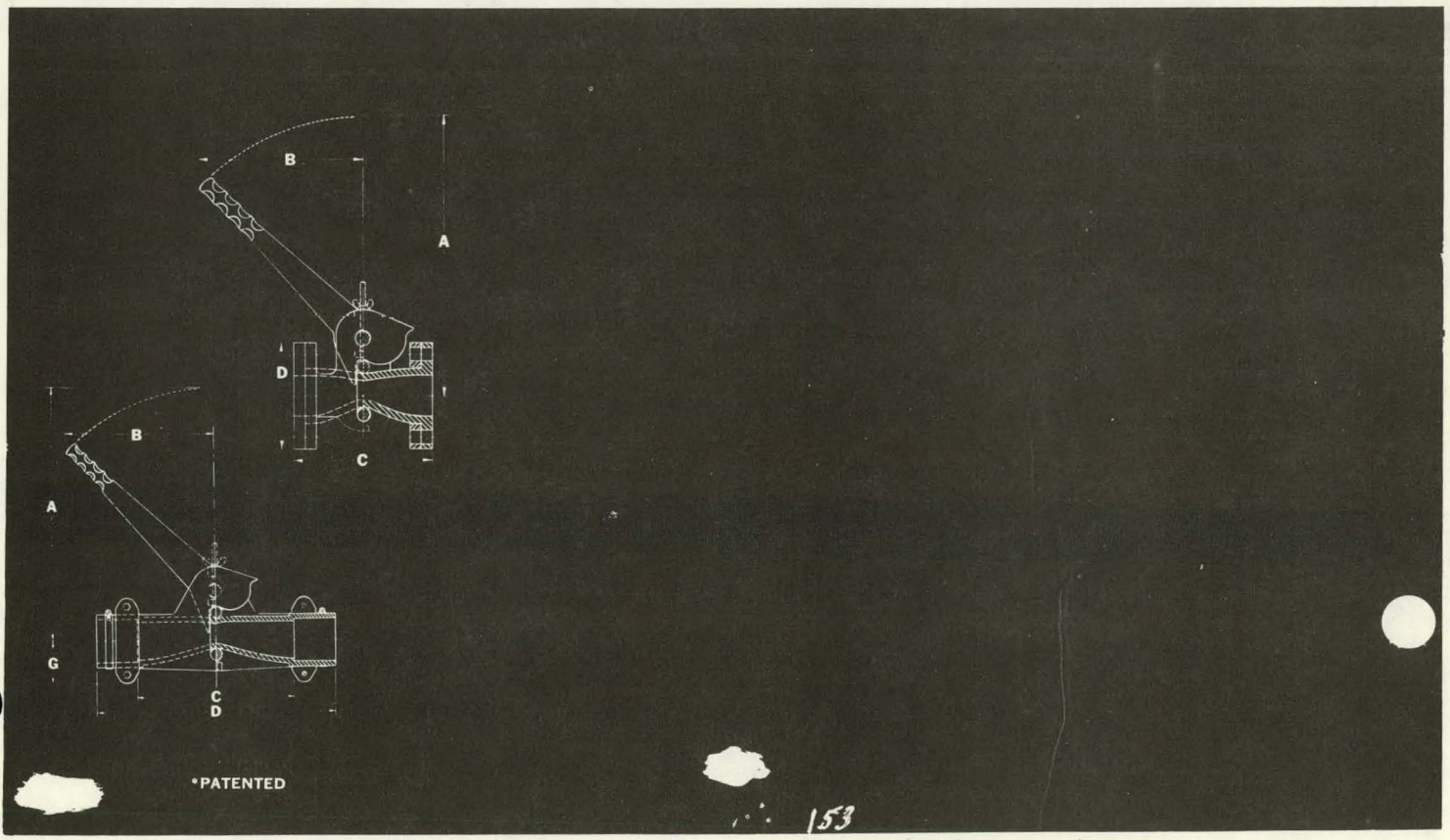
The limiting factor for line pressure is not based on the rubber or elastomeric body but on the force required to actuate the hand lever. These valves are fully self supporting and flow may be in either direction.



TYPE "KHL" HAND-LEVER-OPERATED VALVE
Enlarged End (Slip-on) Connections



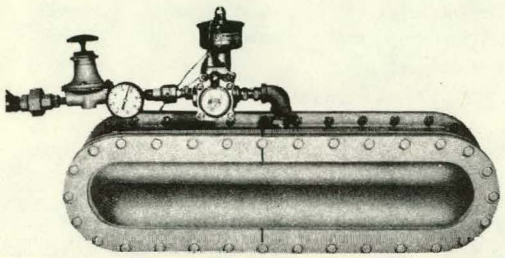
TYPE "KHLF" HAND-LEVER-OPERATED VALVE
Flanged Connections



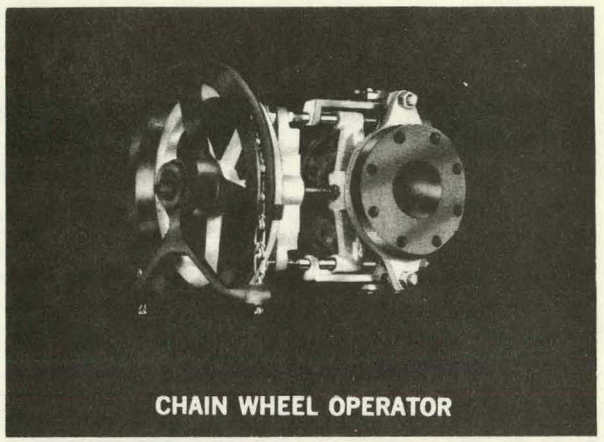
*PATENTED

SPECIAL PINCH VALVES

RKL Controls is noted for developing special pinch valves to fit special application. Below are listed a few of the more recent special designs, some of which are now in our product line.

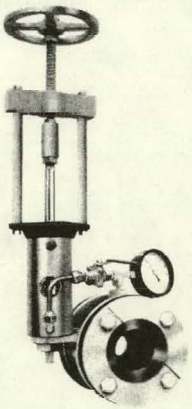


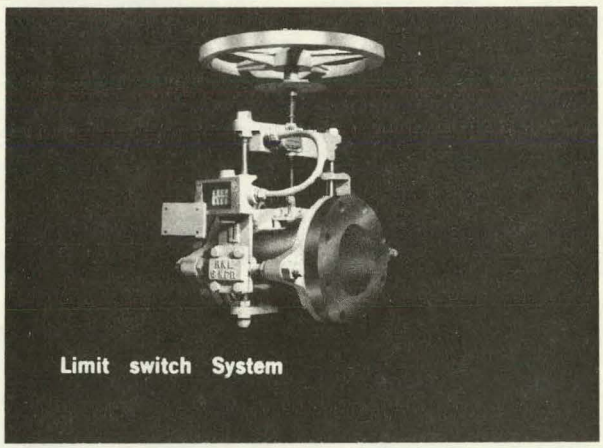
Oval Valve — developed to take the discharge from the full width of a conveyor belt.



CHAIN WHEEL OPERATOR

Infinitely Variable Orifice Valve (with handwheel operated hydraulic actuator) designed for throttling service maintains round configuration

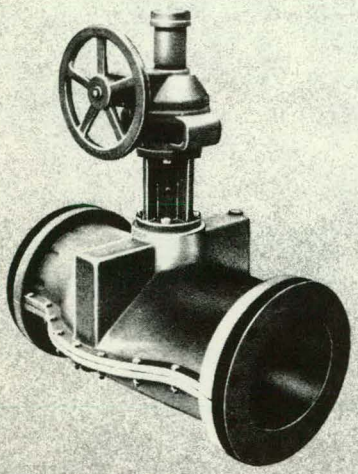




Limit switch System

SERIES LHW-BG BEVEL GEAR OPERATED PINCH VALVES

LOW TORQUE MANUALLY OPERATED



LHW-BG

PINCH VALVE OPERATION: Turning the hand wheel activates the pinch valve stem either raising or lowering the pinch bar to fully open the valve or close air or liquid tight on grits up to 1/8".
In throttling applications the bevel gear operator controls the degree of opening without drifting when subjected to line pressure.

PINCH VALVE CONSTRUCTION: Cast Iron or Aluminum housing, Bevel gear operator, 303 S/S stem, mechanical stop on stem to prevent over-pinching, 125/150# or 250/300# ANSI flange connections, fully molded pinch valve elastomer body (liner). All valves are factory tested and set for your application.

VALVE BODY MATERIALS: Pure gum rubber, Neoprene, Hypalon, Butyl, Buna N (Nitrile), Viton, EPDM (Nordel), Silicone, FDA Rubber, O & T Butyl and Neoprene.

APPLICATIONS: Tailings, Milk of line, Limestone, Wet cement, Leaching, Copper, Zinc, Fly ash and other mineral slurries, Chemical Electrolytes, Dry powders, Granular materials, Sewage sludge and many chemical applications.

- **125/150# & 250/300# ANSI FLANGES**
- **ELASTOMERIC LINERS**
- **ALUMINUM & CAST IRON CONSTRUCTION**
- **SIZES 4" THRU 16"**

For more complete details see Bul. 675

3-WAY DIVERTER PINCH VALVE—STANDARD 125/150 ANSI FLANGE CONNECTIONS—TOTALLY ENCLOSED—CAST IRON OR ALUMINUM HOUSING—HAND LEVER, PNEUMATIC, HYDRAULIC OR ELECTRIC OPERATOR—PARTIAL OR COMPLETE DIVERSION OF FLOW—NATURAL OR SYNTHETIC RUBBER BODY

3 WAY

*DIVERTER PINCH VALVE

The RKL three-way diverter valve was developed to serve in place of two valves used in conjunction with a "Y" fitting, while retaining all the inherent advantages of a pinch valve. As a result of this simplification, costs are lowered and space requirements significantly reduced.

OPERATION: The DV* series diverter pinch valve operates by rotary actuation of a drive shaft by a handlever, a pneumatic or hydraulic linear actuator, or an electric actuator to operate a double pinching mechanism. When either leg of the diverter valve is completely closed, the other leg will be completely open. Through use of a positioner, mixing or partial separation (depending on direction of flow) can be accomplished with capacities of the two legs being inversely proportional to one another in an even curve. As with all RKL pinch valves, the DV* series valves are adjusted and tested to close gas-tight at the maximum line pressure to be encountered in the working environment for which they are ordered. Each leg, when open, maintains full-round configuration.

CONSTRUCTION: The housing is composed of two halves and is available in cast-iron or aluminum. The pinching mechanism is composed of cast-iron and #303 stainless steel parts with Teflon and Nylar bearings. The heart of the valve is the rubber body (sleeve). The body is constructed of the highest quality elastomers (Natural or synthetic) with high-tensile fabric reinforcement and is fully molded during vulcanization (including integral 125/150 pound ANSI standard flanges) to insure maximum quality and absolute uniformity.
The following elastomers are available: Pure Gum Rubber (Natural Rubber), Neoprene, Hypalon†, Buna N, Butyl, Viton†, EPD (Nordel†), and Food-grade elastomers including white odorless and tasteless Neoprene or Butyl and FDA rubber. Other elastomers available upon application.

RKL's patented positive opening feature is standard on all RKL DV* series valves and replacement bodies. Position indicating limit switches are available as an accessory. Any type of actuator can be adapted to the DV* series mechanism upon customer application. Sizes from 1½" to 10". Larger or smaller sizes upon application.

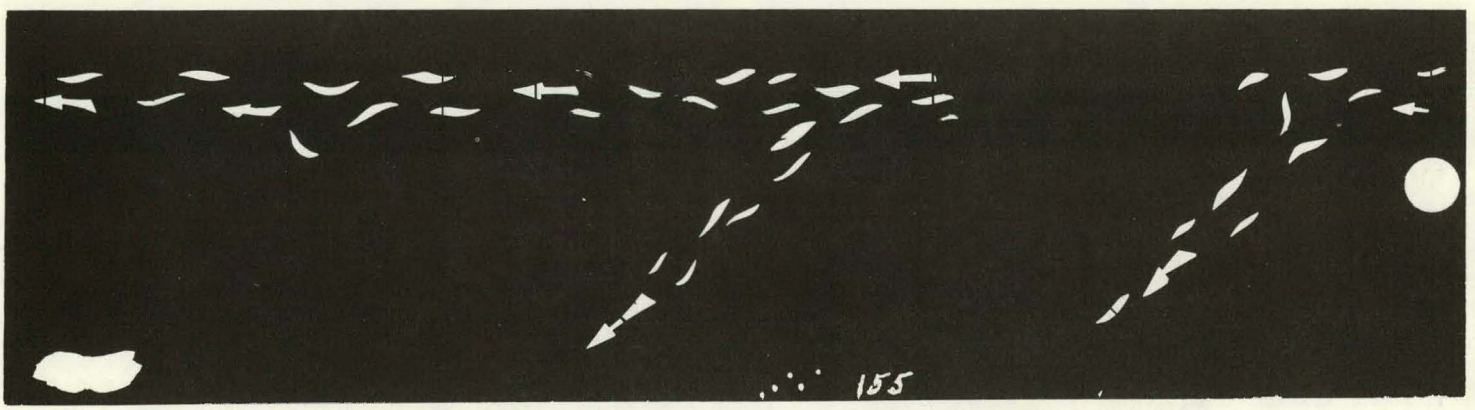
MAINTENANCE: Other than lubrication of the mechanism, no maintenance or cleaning is required for the life of the valve. When the rubber body wears out, replacement is simple and inexpensive.

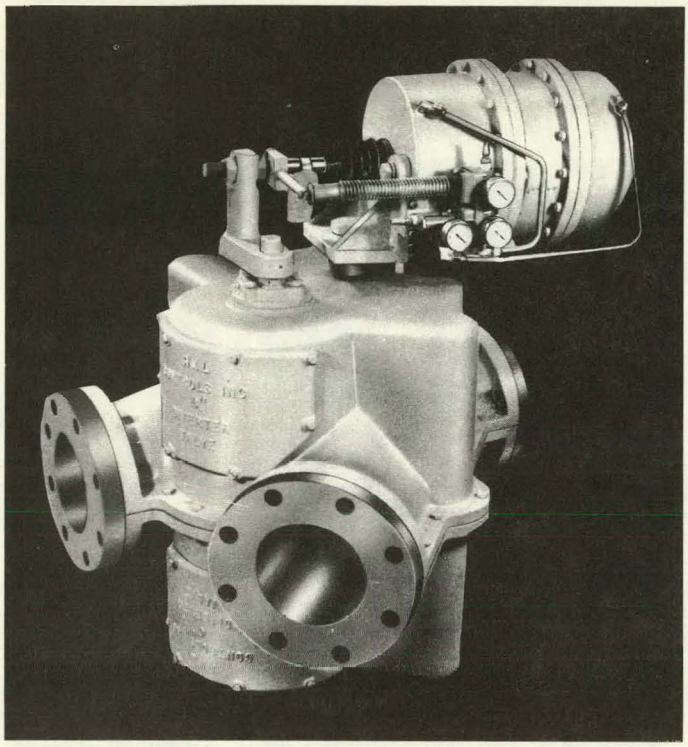
APPLICATIONS: The series DV* valve is currently being used for all sorts of slurries and veying of dry materials from cement to food. Selection of elastomers enables the valve to be matched to the application for the best possible resistance to abrasive and/or corrosive substances. The DV* valve is especially well suited to applications of mixture or dispersal of materials. Typical applications include a constant feed system for filling bins, bags, or vats whereby one container is filled while the container in the alternate position is changed. The DV* series valve can also be used with a positioner to introduce a substance into a closed loop, or alternatively to allow material in a closed loop to escape (continuous by-pass). The obvious advantages in the continuous by-pass application are:

1. maintenance of velocity (to prevent precipitation of suspended solids)

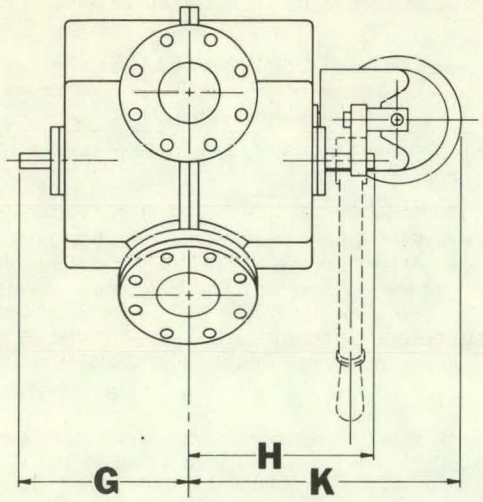
2. reduction of wear through stabilization of back pressure on pump. The unique attributes of the pinch valve and the varied potential of a diverter valve are combined to make the RKL DV* series diverter pinch valve one of the most broadly applicable valves available to industry.

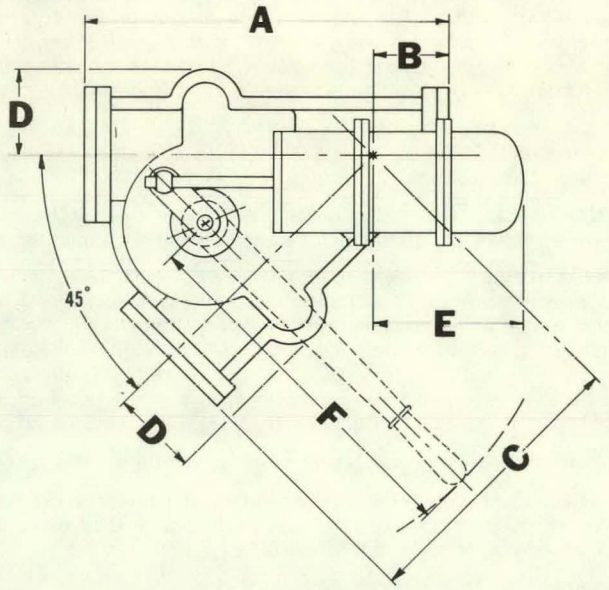
*Patented †E. I. duPont Co. trademarks





SERIES DV





CAPACITIES AND CONTROL VALVE

SIZING PROCEDURES

STEP 1 SLURRIES CORRECTION:

0-7% Solids use specific gravity correction GPM+K
8-30% Solids multiply required GPM x 1.55
31-60% Solids multiply required GPM x 2.00

STEP 2 FLOW CONTROL VALVE SIZING

Solve: $C_v = \frac{Q_L}{\sqrt{\Delta P}}$

Q_L =(GPM) Correct for Specific Gravity or Percentage Solids

ΔP = Pressure drop across valve

ΔP = P_1 (MINUS) P_2

P_1 = Pressure to inlet of valve

P_2 = Pressure loss downstream of valve

Pick the correct valve size from C_v's shown below

STEP 3 FIND PERCENTAGE OF VALVE OPEN

$\frac{\text{Calculated } C_v}{\text{Rated } C_v}$ = Flow Factor

Plot Flow Factor on Flow Curve Chart

GASES

Solve: $C_v = \frac{Q_G}{1390 \sqrt{P \, \Delta P / GT}}$

Q_G = capacity in cu. ft./hr.

P = inlet pressure (psia)

ΔP = pressure drop across valve (psi)

G = specific gravity at flowing conditions

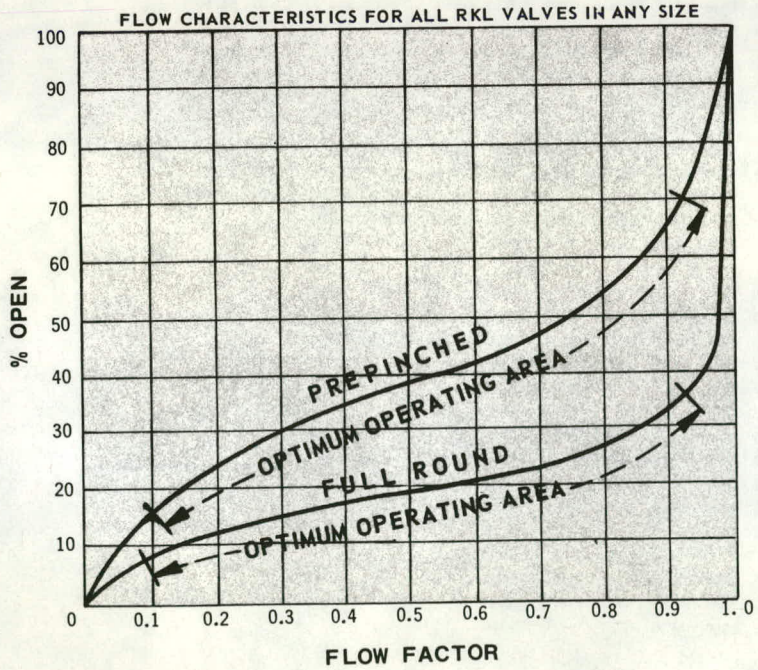
T = absolute Fahrenheit temperature (°F + 460)

Pick the correct valve size from C_v's shown below.

CONVERSION FACTORS

G.P.M. any liquid = 7.47 ×7Cfm.
Water = 8.35 lbs./gallon
1 Imp. (British) gallon = 1.2 U.S. gallons
°C = (°F − 32) × .556
°F = °C × 1.8 + 32
Head water = psig. × 2.2
U.S. gallons in one cubic ft. = 7.48
Doubling diameter of valve increases capacity 4 times at 100% open

Valve Size	¼"	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
C_v	1.3	5	12	21	33	47	83	130	187	332	519	747	1330	2075	2980	4150	5320	6800	8300	11920



SPECIFIC GRAVITY CORRECTION FACTORS VALVE SIZING

for gases (Air = 1) and Liquids (Water = 1)

Sp. Gr.	K	Sp. Gr.	K	Sp. Gr.	K
.0692	3.801 (H2)	1.02	0.990	2.70	0.609
.070	3.779	1.04	0.981	2.80	0.598
.080	3.535	1.06	0.971	2.90	0.587
.090	3.333	1.08	0.962	3.00	0.577
.100	3.126	1.10	0.953	3.10	0.568
.138	2.691 (Helium)	1.12	0.945	3.20	0.559
.150	2.581	1.14	0.937	3.30	0.550
.200	2.240	1.16	0.928	3.40	0.542
.250	2.000	1.18	0.921	3.50	0.535
.300	1.825	1.20	0.913	3.60	0.527
.350	1.688	1.25	0.895	3.70	0.520
.400	1.580	1.30	0.877	3.80	0.513
.45	1.489	1.35	0.861	3.90	0.506
.50	1.414	1.40	0.845	4.00	0.500
.55	1.350	1.45	0.830	4.10	0.494
.60	1.290	1.50	0.817	4.20	0.488
.65	1.240	1.55	0.803	4.30	0.482
.70	1.195	1.60	0.791	4.40	0.477
.75	1.155	1.65	0.779	4.50	0.472
.80	1.117	1.70	0.768	4.60	0.466
.82	1.104	1.75	0.756	4.70	0.461
.84	1.091	1.80	0.745	4.80	0.456
.86	1.078	1.90	0.725	4.90	0.452
.88	1.066	2.00	0.707	5.00	0.447
.90	1.055	2.10	0.690		
.92	1.043	2.20	0.674		
.94	1.031	2.30	0.659		
.96	1.021	2.40	0.645		
.98	1.010	2.50	0.633		
1.00	1.000	2.60	0.620		

SIZING INFORMATION

APPLICATIONS

QUICK REFERENCE FOR SIZING ONLY

(Not to be used to determine ΔP thru a pinch valve controlling flow)

STEP 1 CORRECT GPM FOR SPECIFIC GRAVITY OR PERCENTAGE SOLIDS

STEP 2 DETERMINE $\Delta P = P_1$ (MINUS) P_2

STEP 3 ENTER ΔP UNDER ΔP PSI COLUMN

STEP 4 READ ACROSS TO THE FIRST VOLUME WHICH EXCEEDS THE GPM DETERMINED IN STEP 1

STEP 5 READ UP TO THE VALVE SIZE

EXAMPLE: CORRECTED GPM=630 ΔP= 4 PSI SIZE 4" VALVE

P_1 (MINUS) P_2

ΔP — VALVE SIZE

PSI	1/4"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
1	1.3	5	12	21	33	47	83	130	187	332	519	747	1330	2075	2980	4150	5320	6800	8300	11920
2	1.7	7	16	29	46	66	117	183	264	468	730	1052	1850	2925	4200	5860	7520	9630	11720	16870
3	2.2	9	20	36	56	81	144	225	324	574	890	1291	2300	3590	5150	7180	9170	11760	14360	20650
4	2.5	10	23	42	65	94	166	260	374	664	1030	1495	2680	4150	5960	8320	10610	13590	16590	23840
5	2.8	12	26	46	73	105	186	291	418	744	1160	1672	2980	4650	6680	9270	11860	15200	18540	26630
6	3.1	13	29	51	80	115	203	318	448	813	1270	1830	3260	5080	7300	10150	12990	16620	20300	29220
7	3.3	14	31	55	86	125	220	342	496	880	1365	1980	3525	5500	7900	10950	14010	17980	21930	31560
8	3.5	15	33	59	92	132	235	368	529	940	1460	2115	3765	5870	8440	11720	14990	19230	23450	33710
9	3.7	16	35	62	98	140	249	390	562	995	1540	2240	3990	6225	8940	12430	15920	20420	24500	35820
10	3.9	17	37	66	103	147	261	411	588	1045	1620	2360	4200	6550	9420	13110	16780	21480	26250	37680
15	4.8	20	45	80	126	181	321	503	724	1285	2005	2890	5150	8025	11500	16050	20580	26300	32100	46150
20	5.5	23	52	93	145	209	371	581	835	1485	2300	3340	5950	9275	13300	18540	23750	30210	37090	53350
25	6.2	26	59	104	163	234	415	650	935	1660	2660	3735	6650	10350	14900	20720	25520	33940	41430	59690
30	6.8	28	64	114	178	256	454	713	1025	1820	2840	4095	7280	11350	16300	22700	29050	37200	45420	62580
35	7.4	31	69	123	192	277	493	770	1108	1970	3070	4425	7880	12290	17600	24520	31380	40190	49080	70560
40	7.9	33	74	131	206	296	525	823	1182	2100	3280	4725	8410	13100	18800	26210	33600	42990	52480	75500
45	8.4	35	79	139	218	314	557	873	1255	2230	3470	5100	8930	13900	20000	27820	35500	45600	55610	80100
50	8.8	37	83	147	230	330	587	920	1322	2345	3660	5285	9420	14680	21000	29350	37510	48080	58600	84350
55	9.2	38	87	154	241	347	616	965	1388	2465	3850	5545	9860	15390	22000	30600	39390	50380		
60	9.6	40	91	161	252	362	643	1009	1450	2570	4015	5790	10310	16090	23200	32100	41100	52610		
65	10.0	42	94	167	262	377	669	1050	1508	2675	4180	6020	10630	16580	23800	33410	42810	54750		
70	10.4	43	98	174	272	391	695	1090	1565	2780	4335	6230	11100	17310	24900	34700	44480	56860		
75	10.8	45	101	180	282	405	720	1125	1620	2875	4470	6470	11510	17960	25800	35900	45990	58750		
80	11.2	46	105	185	290	418	741	1160	1670	2960	4630	6680	11900	18520	26650	37100	47510	60810		
85	11.5	48	108	191	300	431	765	1200	1730	3060	4780	6910	12300	19210	27450	38300	48990	62670		
90	11.8	49	111	197	308	443	787	1231	1780	3150	4920	7100	12650	19700	28250	39350	50400	64450		
95	12.2	51	114	202	317	456	810	1268	1825	3250	5060	7280	12950	20210	29010	40400	51710	66280		
100	12.5	52	117	208	325	467	830	1300	1870	3330	5180	7450	13280	20750	29800	41500	53200	68100		
110	13.1	53	123	218	350	490	870	1360	1960	3490	5430	7850	13900	21750	31230	43500				
120	13.7	55	131	228	366	512	910	1420	2050	3640	5680	8150	14500	22720	32600	45400				
130	14.2	57	137	237	380	532	945	1475	2130	3780	5920	8530	15170	23650	33980	47300				
140	14.8	59	142	246	394	551	980	1530	2210	3920	6140	8850	15710	24550	35250	49100				
150	15.3	61	147	254	407	570	1010	1580	2280	4050	6340	9150	16300	25400	36500	50700				
160	15.8	63	152	262	418	594	1050	1640	2365	4200	6560	9450	16820							
170	16.3	65	156	270	430	613	1080	1690	2440	4330	6760	9740	17320							
180	16.8	67	161	278	443	631	1110	1745	2510	4450	6960	10050	17850							
190	17.2	69	165	286	454	648	1145	1790	2575	4570	7140	10300	18450							
200	17.7	71	169	293	466	664	1172	1835	2645	4690	7340	10550	18800							
210	18.1	73	174	304	478	682	1201	1883	2710	4810	7530	10830	19250							
220	18.5	74	177	311	485	697	1230	1925	2775	4920	7680	11070	19750							
230	18.9	76	182	318	505	714	1257	1975	2835	5030	7870	11320	20150							
240	19.4	78	186	325	512	728	1285	2013	2898	5140	8030	11570	20600							
250	19.6	79	189	332	522	744	1310	2055	2955	5250	8220	11720	21200							
260	20.1	80	193	338																
270	20.5	82	197	345																
280	20.9	84	210	351																

CHEMICAL RESISTANCE CHARTS

RKL Controls has been a leader in developing special compounds of standard rubbers and elastomers for use specifically in pinch type valves. We were the first to use a Hypalon, Viton, and Silicone compound in standard pinch valve bodies.

The object in developing a compound for high abrasion resistance is to maintain as high a tensil strength as possible with as low a durometer (softness) as possible. A slurry particle flowing in a line will then bounce off the internal surface of the pinch vale body without cutting the rubber or elastomer. Standard friction abrasion tests cannot be used to measure abrasive impingement wear, as occurs in a pinch valve. Highly loading a rubber or elastomer, to decrease its cost, only increases its durometer and its resistance to closure as well as decreasing its resistance to impingement type abrasion.

The object in developing a compound for high chemical resistance is to pick the most highly resistant elastomer and develop a formulation which does not lose its chemical resistance as extenders, curing agents, and fillers are added. It also must be kept in mind that a low durometer offers the best seal on closure with the least amount of force required to close and that a high tensil strength will offer longer life of the elastomer as it is stretched and stressed upon closure of the pinch valve.

RKL has developed all their compounds with the above parameters in mind and believes it has the best compounds, with the broadest range available to industry.

The data listed below is meant only as a guide. When a question, borderline case or a chemical is not listed, our factory should be consulted. We will be glad to furnish test slabs of various compounds for evaluation in your own laboratories.

S-satisfactory
D-doubtful
U-not recommended
F-fair
BLANK-no experience

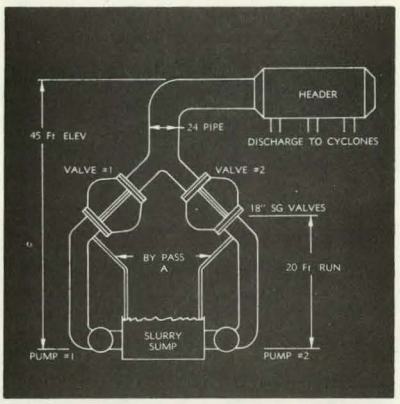
	NATURAL RUBBER	BUNA-S (SBR)	BUTYL	HYCAR (BUNA-N)	NEOPRENE	HYPALON	SILICONE	VITON	EPDM	HERCLOR
Acetic Acid-Vapors	F	F/S	S	F/SF/S	S	S		S		S
Acetamide	F/DF/D	S		S	F	F		S		S
Acetic Acid(Crude or Pure)	F	F	F/S	F	F	F	S	S		S
Acetic Acid,Hot High Pressure	U	U	F/SD/UD/U		D	F	U			D
Acetic Acid, 30%	D		D	F/D	D	F	S	S	S	S
Acetic Acid, Glacial	D	F/S	F	U	D	D	F	S	F	S
Acetic Anhydride	S	F/SF/SF/S			S	S	F/D	S		F
Acetone	F/SF/S	S	U	F/SF/S		S	S	S	S	U
Acetylene	S	S	S	S	F/SF/SF/D			S	S	S
Acrylonitrile	S	U	F	U	S	F/S		S		U
Air 200°F	S	S	S	S	S	S	S	S		S
Alkasene					U	U		F/S		
Alums	S	S	S	S	S	S	S	S		S
Aluminum Acetate	S		S	S	S	S		U		F
Aluminum Chloride	S	S	S	S	S	S	F/S	S	S	S
Aluminum Fluoride	S	S	S	S	S	S	F/S	S		S
Aluminum Nitrate	S	S	S	S	S	S	F/S	S		S
Aluminum Sulfate	S	S	S	S	S	S	S	S	S	S
Amines Mixed			F/S	F	F/SF/S		F	U		U
Ammonia Anhydrous			S	S	S	F/D	S	S		U
Ammonia Gas Hot	F/DF/DF/SF/DF/SF/S						S	S		U
Ammonia Liquid	F/DF/D	S	F/SF/DF/D				S	S		U
Ammonia Carbonate			S	U	F	F	F/S	S		S
Ammonia Chloride	S	S	S	S	S	S	F	S	S	S
Ammonium Hydroxide	F/SF/S	S	F/S	S	S	S	S	S	S	U
Ammonium Nitrate	S		S	D	S	S	F	S		S
Ammonium Persulfate	S		S		S	S		S		S
Ammonium Phosphate	S		S	S	S	S	S	S		S
Ammonium Mono-Di-Tri	S		S	S	S	S	S	S		S
Ammonium Sulfate	S		S	S	S	S	S	S	S	S
Ammonium Thiocyanate	S	S	S		S	S				
Amyl Acetate	F/D	U	F/D	U	U	U	D	U	F/S	S	F
Amyl Alcohol	S	S	S	S	S	S	D/U	S	S	S
Amyl Borate	U	U	U	S	S	S		S		S
Amyl Chloronaphthalene	U	U	U	S	D	D		S		S
Aniline	S	F/SF/S	U	F	F/D	F	S	F/S	U	
Aniline Hydrochloride	S	F/SF/S		F	F		F		U	
Animal Oil (Lardoil)	U	U	S	S	D	D	S	S		S
Aqua Regia (Conc.)	D	D	F	U	D	F	F/D	S		U
Aresenic Acid	S				S	S		S		S
Asphalt	U	U	U	U	F/S	F	F/S	S		S
Barium Chloride	S	S	S	S	S	S	S	S		S
Barium Hydroxide	S	S	S	S	S	S	S	S	S	S
Barium Sulfate	S	S	S	S	S	S	D/S	S		S
Barium Sulfide	S		S	S		S	F/S	S		S
Beer	S	S	S	F/DF/S		S	S	S		S
Beet Sugar Liquors	S	S	S	S	S	S	S	S		S
Benzene Benzol	U	U	F/D	U	U	U	D/U	S		U
Benzene	U	S	U	S	U	U	D/U	S	D	U
Benzaldehyde	D/U	U	S	U	U		S	D	F	U
Benzyle Alcohol	S	F	S	U	F			S		U
Benzyl Benzoate	F/D	U	S	U	U			S		U
Benzyl Chloride	F/D	D	S	U	U			S	D	U
Black Sulfate Liq.	S	S	S	S	S		F	S		S
Blast Furn., Gas	F/DF/DF/D			F	F		S	S		
Borax	S	S	S	S	S	S		S	S	S
Boric Acid	S	S	S	S	S	S	F/S	S	S	S
Bordeaux				S	S	S		S		
Boron Fuels (HEF)								S		
Brake Fluid (Veg.)	S	S	S	S	S	S		S		U
Bromine	U	U	U	U	U	D	U	S	D	U
Bunker Oil	U	U	U	S	S	S	F	S		S
Butane	U	U	D	F/SF/SF/S			U	S	F	S
Butyl Acetate	U	U	F	U	U	U	U	F/S		U
Butyl Acryl Ricinoleate	D	U	S	F/D	U	D		F/S		U
Butyl Alcohol,Butano X	S	S	S	S	S	S	F	S		S
Butyl Amine			F/D	S	U	D	S	F/S		U
Butyl Carbitol			S	S	S	S	S	S		U
Calcium Acetate	S		S	S	S	S		U		S
Calcium Bisulfite	S	S	S	S	S	S	S/F	S	U	S
Calcium Chloride	S	S	S	S	S		S	S	S	S
Calcium Hydroxide	S	S	S	S	S	S		S	S	S
Calcium Hypochlorite	S		S		F	S/F		S	S	F
Calcium Nitrate	S		S	S	S	S	F	S		S
Calcium Sulfide			S	S	S	S	F	S		F
Calcine Liquors			S	S	S	S		S		S
Cane Sugar Liquors	S	S	S	S	S	S		S		S
Carbolic Acid (Phenol)	F/D	D	S	D/UF/DF/D			U	S		U
Carbon Bisulfide (Di)	U	U	U	F	U	U		S	U	S
Carbon Dioxide	S	S	S	S	S	F	S	S	U	S
Carbonic Acid	S	S	S	S	S	S	S	S		S
Carbon Tetrachloride	U	U	U	F/D	U	U	U	S	D	F
Cellosolve, Acetate	F	F	S	U	U	U		S		U
Cellosolve, Butyl	S	S	S	S	F	S		S		U
Chlorine	D	D	F/D		D	F/D	U	S		F
Chlorine Dioxide			U		U	F	D	F/S		U
Chlorine Trifluoride			F/D		D	F/D	D	F/S		U
Chlorinated Salt Brine	S		F/D		F	F	U	S		U
Chlorinated Solvents	U	U	U	D/U	U	U	U	S		F
Chloroacetone		F/D	U	F	F	S	U	S		U
Chloroacetic Acid		F/D	S	F/DF/D		S		S		S
Cholorohezine	U	U	U	U	U	D	U	S		U
Chlorobromomethane			D	U	U	U	D	S		U
Chlorobutadiene			U		D	D	D	S		F
Chloroform	U	U	U	U	U	U	D	S		U
o-Chloronaphthalene	U	U	U	U	U	U	D	U		U
1 Chlorol Nitro Ethane	U	U	U	U	U	U	D		F	U
Chlorosulfonic Acid	U	D	U	U	U	U	U	U		U
Chlorox	S		S		S	S		S		U
Chrome Plating Solution	U	U	F/S	U	U	U	F	S		U
Chromic Acid	U	U	F/S	U	U	S	F/S	S		U
Citric Acid	S	S	S	S	S	S	S	S	S	S
Circo Light Process Oil	U	U	D	S	S	S	F/D	S		S
Coke Oven Gas	D	D	D	F/DF/D		S	S	S		S
Copper Chloride	S	S	S	S	S	S		S	S	S
Copper Cyanide	S		S		S	S		S		S
Copper Sulfate	S	S	S	S	S	S	S	S	S	S
Corn Oil	U	U	S	S	F/D	F	F/D	S		S
Cottonseed Oil	U	U	S	S	F	F/DF/S		S	S/F	S
Creosote(Wood or Coal Tar)	U	U	U	S	F	D	F/D	S	D	U
Cresol, Cresylic Acid	D/U	U	D/UD/U		U	D	F/D	S		U
Cyclo Hexane	U	U	U	S	F/D	U		S	D	S
Cyclehexanone	U	U	F	U	U	U	U	S		U
Deionized Water			S	S	S	S	S	S		S
Denatured Alcohol			S	S	S	S	S	S		S
Developing Solutions (Hypos)	S		F/S		S	S		S		S
Dibenzyl Ether	U	U	S	U	U	U				U
Dibuthylamine				U			S	S		U
Dibutyl Ether			F/S	D	U	U		S		F
Dibutyl Phthalate	U	U	F/D	U	U	D		S	S	F
p-Dichlorobenzene	U	U	U	F/D	U	U	D/U	S		U
Dicyclohexylamine	U	U	U	F/S	U	F		F/S		U
Diethylamine	S	S	S	F/S	S	S		S		U
Diethylene, Glycol	S	S	S	S	S	S	F	S		S
Diethylether	U	U	F	S	F	U	F/U	S		S
Diethyl Sebacate			S	U	U	F/D	S	S	F	U
Di-Ispropyl Ketone	D	D	F/S	U	U	U		F/S		F
Dimethyl Aniline	U	U	S	U	U	U		S		U
Dimethyl Formamide			F/D	S	U	U	S	F/S		U
Dinitro Toluene				U	U	U	F	S		U
Dioctyl Phthalate	U	U	S	F/S	U	D		S	F	F
Dioctyl Sebacate			S	U	U	U	S	S		D/F
Dioxane	U	U	S	U	U	U		S		U
Dipentene	U	U	U	F/S	U	U		S		S
Diphenyl	U	U	U	U	U	U	D	S		U
Diphenyl Oxides	U	U	U	U	U	D	F/S	S		U
Epichlorohydrine			U					U	F	U
Ethanolamine	S	S	S	S	F/S	S		S		F/S
Ethers	F	F	F	F	F	S		S		
Ethyl Acetate	D/UD/U	S	D/U	U	U	F/S	U	S	U	
Ethyl Acrylate							U		U	
Ethyl Alcohol	S	S	S	S	S	S	S	S	S	S
Ethly Benzene	U	U	U	D	U	U	U	S		U
Ethyl Cellulose	F/SF/S	F	F/SF/S		F	F	S			S
Ethyl Chloride	S	F/S	S	F/SF/S	U	D	S	F	F	
Ethylene Diamine	S	F/S	S	S	S	S		S		U

CHEMICAL RESISTANCE CHARTS

	NATURAL RUBBER	BUNA-S (SBR)	BUTYL	HYCAR (BUNA-N)	NEOPRENE	HYPALON	SILICONE	VITON	EPDM	HERCLOR
Ethylene Dichloride	U	U	U	U	U	U	F/D	S	F	U
Ethylene Oxide			F/S	U	U	U	D	F/S		U
Ethylene Glycol	S	S	S	S	S	S	S	S	S	S
Ethyl Ether	U	U	F/S	F/D	D	U	D	S	D	F
Ethyl Mercaptan	U	U	U	U	U	U		S		U
Ethyl Oxalate	S	S	S	U	F/D			S		U
Ethyl Pentachlobenzene	U	U	U	F/D	U	U		S		D/F
Ethyl Silicate	F	F	S	S	S	S		S		S
Fatty Acids	D	D	U	F	F	F/D	F	S		S
Ferric Chloride	S	S	S	S	S	S	F/S	S	S	S
Ferric Nitrate			S	S	S	S	D	S		S
Ferric & Ferrous Sulfate	S	S	S	S	S	S	F	S		S
Fluorboric Acid	S				S	S		S		
Fluorine (Liquid)			F/D				U	S		U
Fluorochloroethylene			D	U				S		U
Fluorinated Cyclic Ether			F/S					S		
Fluosilicic Acid	S				F/S	S		S	U	S
Formaldehyde	S	S	S	F/S	S	S	S	S	S	F/S
Formic Acid	S	S	S	F/S	S	S	F/S	F/S	S	F
Freon 11			F/D	F	D	F	F/U	S	D	S
Freon 12	U	D	S	F	S	S	U	S	F	S
Freon 21	U	U	F/D	U	D/U	D	F/U	S		F/S
Freon 22			S	U	S	S	U	S	D	S
Freon 113			U	F	F	F	F/U	S	D	S
Freon 114			F/D		F/S	S	F/U	S	D	S
Fuel Oil Acidic	U	U	U	S	F	F	S	S		S
Fumaric Acid	S				F	S		S		S
Furfural	F/D	D	S	U	F/S	F/DF	D	S	F	U
Gallic Acid	S							S		
Gasoline	U	U	U	S	F/S	F/S	F/D	S	F/D	S
Gelatin	S	S	S	S	S	S		S		S
Glauber's Salt	S	S			S	S		S		S
Glucose	S	S	S	S	S	S	S	S		S
Glue	S	S	S	S	S	S	S	S	S	S
Glycerin	S	S	S	S	S	S	S	S	S	S
Glycols			S	S	S	S	S	S		S
Green Sulfate Liquor	S	S	S	S	S		S	S		S
n-Hexaldehyde	U	U	S	U	U		S	S		S
Hexane	U	U	U	S	S	S	F/S	S	D	S
Hexyl Alcohol			S/F	S	S	S	F	S		S
High Energy Fuels								S		
Hydraulic Oil	U	U	U	S	S	S	F/S	S		S
Hydro Bromic Acid	S	S/D	S	F/DF	D	S		S		U
Hydrochloric Acid (Cold)	S	F/S	S	S	F/S	S	S	S	S/F	S
Hydrochloric Acid (Hot)	U	U	S	F/DF	DD	UF	U	S	S/F	S
Hydrochloric Acid 37%			S	S	S	S	F	S	S/F	F
Hydrocyanic Acid	F/S	S/F	S	F	F	S		S	S	
Hydrofluoric Acid 48%	F	F	S	F	S	S	U	S	F	U
Hydrofluoric Acid 75%	D	UD/U	S	U	D/U	S	U	S	D	U
Hydrofluoric Acid Anhydrous	S	U	D		D	D		S	D	U
Hydrofluilicic Acid	S	S/F	S	S	F	S	U	S		U
Hydrogen	S	S	S	S	S	S	S	S	S	S
Hydrogen Peroxide	F/S	F/S	S	S	S	D	S	S		U
Hydrogen Peroxide 90%			S	S	S	S	S	S	U	U
Hydrogen Sulfide	S	F/S	S	S	S	S		S	S	F
Hypochlorous Acid	S	F/S						S		F/S
Isobutyl Alcohol	S	F/S	S	F	F	S		S		F
Iso-Octane	U	U	U	U	F/S	S	U	S		S
Isopropyl Acetate	F/D	U	S	U	U	U		S		S
Ispropyl Alcohol	S	F/S	S	F	F	S	S	S	U	S
Isopropyl Chloride	U	U	U	F/D	U	U	D	S		F
Isopropyl Ether	U	U	F/D	S	F	F/D		S	D	S
JP-1 to JP-6 Fuels	U	U	U	S	F/DF	D	U	S	D	S
JP X	U	U	U	S	F	F	U	S		
Kerosene	U	U	U	S	F/S	U	U	S	D	S
Lacquers	U	U	D/U	U	U	U		S		U
Lacquer Solvents	U	U	D/U	U	U	U		S	D	U
Lard	U	F/D	S	S	S	F	F	S		S
Lead Acetate	S		S					S		F/S
Lead Nitrate	S		S		S	S		S		S
Lead Sulfamate							F	S		S
Liquified Petroleum Gas	U	U	U	S				S		S
Liquid Oxygen			S	F	F	F	F	S		
Lubricating Oil	U	U	U	S	S	F	F/S	S		S
Magnesium Chloride	S	S	S	S	S	S		S	S	S
Magnesium Hydroxide	S	S	S	S	S	S		S	S	S
Magnesium Sulfate	S	S	S	S	S	S		S		S
Maleic Acid	S		D					S		S
Malic Acid	S		D					S		S
Mercuric Chloride	S	S	S	S	S	S		S	S	S
Mercury	S	S	S	S	S	S		S	S	S
Mercury Vapor	S		S	S				S		S
Mesityl Acetate			F	U			D	S		U
Mesityl Acrylate				U				S		U
Mesityl Butyl Ketone	U	U	F	U	U	U	S	U		U
Methyl Chloride	D	D	F/S	D	D	U	F/D	S		U
Methyl Ethyl Ketone	U	U	S	U	U	U	S	U	S	U
Methyl Isobutyl Ketone	U	U	F	U	U	U	S/F	U		U
Methyl Isopropy Ketone			F	U	U	U	S	U		U
Methyl Methacrylate	U	U	F/D	U	U			U		U
Methyl Salicylate			S	U	U			S		U
Methylene Dichloride			U	U	U	U	D	S		U
Milk			S	S	S	S	S	S		S
Mineral Oil	D	UD/UF	D	S	F/SF	S	S	S	D	S
Monobromo Benzene	U	U	U	U	U	U	U	S		U
Monochloro Benzene	U	U	U	U	U	U	U	S		U
Mono Ethanolamine			S	S			F	S		U
Naptha	U	U	U	F/SD	U	D	F/D	S	D	S
Napthalene	U	U	U	U	U	U		S	D	F
Natural Gas	F	F	U	S	S	S	F	S		S
Nickel Acetate	S		S			S	S	S		S
Nickel Chloride	S	S	S	S	S	S		S		S
Nickel Sulfate	S	S	S	S	S	S		S		S
Nitric Acid Conc.	F/D	D	F/S	U	D	F/S	S	S	D	D
Nitric Acid, Dilute	F	F/D	S	F/D	S	S		S	F	D/S
Nitric Acid, RFNA	U	U	D	U	U	U	U	F/S	D	U
Nitric Acid, Inhibited RFNA	U	U	S	U	U	U	U	F/S	D	U

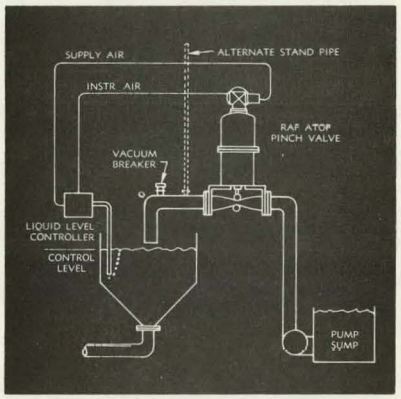
	NATURAL RUBBER	BUNA-S (SBR)	BUTYL	HYCAR (BUNA-N)	NEOPRENE	HYPALON	SILICONE	VITON	EPDM	HERCLOR
Nitro Benzene	D/U	U	S	D/U	U	U	F/D	S	S	U
Nitro Ethane	S	F	S	U	F	S	F/D	S		U
Nitro Methane	S	S	S	U	F		J	S		U
1-Nitropropane	F/DF	D	S	U	F/D		D	F/S		S
Nitrogen	S	S	S	S	S	S	S	S		S
Nitrogen Tetraoxide			F		D	D	D	S		S
Octyl Alcohol			F	S	S	S	F	S		S
Oleic Acid	F/DF	D	U	F/DF	S	D	U	S	F	S
Oleum Spirits	D/UD	UD/U	S	S	S	S	U	S		U
o-Dichloro Benzene			U	U	U	U	D	S		S
Oxalic Acid	F	F	S	F	F	S	F/S	S		D/F
Oxygen Cold	F	F	S	F/S	S	S	S	S		F
Ozone	U	U	S	U	F/SF	S	S	S		S
Palmitic Acid	F	F	S	S	S	D	D/U	S	F	F
Perchloric Acid				U	D		U	S		D
Perchloroethylene			U	U	U	U	F/D	S	D	S
Petroleum Oils	U	U	U	S	S	S	F	S		S
Phenyl Benzene	U	U	U	U	U	U	D	S		U
Phenyl Ethyl Ether	U	U	U	U	U	U		S		U
Phenyl Hydrazine	S	F	F/D	U	D			S		U
Phenol	D	U	S	U	F/DF	D		S	F	U
Phosphate Esters	U	U	S	U	U	U	S	S		U
Phosphoric Acid	F/S	F	S	F/SF	S	S	F/D	S	S	S
Phosphoric Acid 40%			S	F	F/S	S	S	S	S	S
Phosphoric Acid 60%			S	D	F/S	S	S	S	S	S
Picric Acid	F	F	F	F/S	F	S	U	S	F	U
Plating Solutions, Chrome	U		S		U	U	F/D	S		U
Plating Solutions, Others	S	S	S	S	S	S	F/D	S		
Potassium Acetate	S		S	S	S	S		S		S
Potassium Chloride	S	S	S	S	S	S		S		S
Potassium Cyanide	S	S	S	S	S	S		S		S
Potassium Dichromate	S		S		S	S		S	S	
Potassium Hydroxide	S	S	S	F/S	S	S	S	S	S	S
Potassium Nitrate	S	S	S	S	S	S		S		S
Potassium Sulfate	S	S	S	S	S	S	S	S		S
Producer Gas	U	U	S	S	S	S	S	S		S
Propane	U	U	U	S	S	S	F/D	S		S
Propyl Acetate			F/S	U	U		F/D	S		U
Propyl Alcohol	S	S	S	S	S	S	S	S		S
Propyl Nitrate			F/S			D		S		U
Propylene			U	F/D	U	U		S		S
Pyridine	U	U	S	U	U	U		S	F	U
Pyrrole	F	F	U	U	U			S		D
Sal Ammoniac	S	S	S	S	S		F	S		U
Salicylic Acid	S	S		S	S	S		S		S
Salt Water	S	S		S	S	S	S	S	S	S
Sewage	S	S	S	S	S	S	S	S		S
Silicate Esters			S	S			F	S		S
Silicone Greases			S	S	S	S	F/S	S	S	S
Silicone Oils			S	S	S	S	F/S	S		S
Silver Nitrate	S	S			S	S		S		S
Soap Solutions	S	S	S	S	S	S	S	S	S	S
Soap Ash (Sodium Carbonate)	S	S	S	S	S	S	S	S		S
Sodium Bicarbonate	S	S	S	S	S	S	S	S		S
Sodium BiSulfate	S	S	S	S	S	S	S	S		S
Sodium Bisulfite	S	S	S	S	S	S	S	S		S
Sodium Borate	S	S	S	S	S	S	S	S		S
Sodium Chloride	S	S	S	S	S	S	S	S	S	S
Sodium Cyanide	S	S	S	S	S	S	S	S		S
Sodium Hydroxide	S	S	S	F/S	S	S	F/D	S	S	S
Sodium Hypochlorite	S	S	S	S	S	S	S	S	S	S
Sodium Metaphosphate	S	S	S	S	S	S		S		S
Sodium Nitrate	S	S	S	S	S	S	D	S		S
Sodium Peroxide	S	S	S	S	S	S	D	S	S	U
Sodium Phosphates	S	S	S	S	S	S	D	S		S
Sodium Silicate Sulfate	S	S	S	S	S	S		S		S
Sodium Sulfate	S	S	S	S	S	S		S		S
Stannic (ous) Chloride	S	S	S	S	S	S	F/S	S	F	S
Steam under 500°F	F/SF	S	S	F/SF	SF	S	U	U	S	F
Stearic Acid	F	F	U	F	F	F	F/D	S	F	F/S
Stoddards Solvent	U	U	U	F/S	F	D	U	S		S
Styrene	U	U	U	D/U	U	F/DF	D	S	D	S
Sucrose Solutions	S	S	S	S	S	S		S		U
Sulfate Liquors	S	S	S	S	S	S		S		S
Sulfur	F	F	S	S	S	S	S	S	S	S
Sulfur Chloride	U	U	U	F/DF	D	S		S		U
Sulfur Dioxide (Tri)	F	F	S	F/DF	D	U	F	S	S	U
Sulfur Hexafluoride				S		S	S	S		S
Sulfuric Acid, Cold	F/SF	S	S	F/DF	D	S	F/S	S	F	S
Sulfuric Acid, Hot, Con.	U	U	F	U	U	U	U	S	D	D
Sulfuric Acid, Fuming	U	U	U	U	U	U	U	S	D	D
Sulfurous Acid	S	F/S	S	F/SF	S	S	F	S	D	S
Tannic Acid	S	F	S	F/SF	SF	S	F	S	S	U
Tar, Bituminous	F	F/D	U	S	S		F	S		S
Tartaric Acid	S	S	S	S	S	S	S	S	F	F/S
Tetra Bromoethane			U	U			U	S		F
Tetrochloroethane			U	U				S		F
Tetra Ethyl Lead			U		U			S		S
Tetralin	U	U	U	F/D	U	U	D	S		D
Thionyl Chloride								S		D
Toluene	U	U	U	F/D	U	U	U	S	D	U
Tributyl Phosphate	F	F/D	F	U	U	U		S	D	U
Tributoxy Ethyl Phosphate	F	F	F	U	F/D			S		F
Trichloroethane		U		U			F/D	S		F
Trichloracetic Acid			U					S		F
Triethanol Amine	S	S	S	S	F/S	S	S	S	S	U
Trichlorethylene (Triad)	U	U	U	U	U	U	U	S		F
Triethyl Borane & Alum.								S		
Triphenyl Phosphate				D			S	F		
Turpentine	U	U	U	S	D	U	D	S	D	S
Vegetable Oils	F/DF	D	S	S	F	S	F/D	S		S
Vinyl Chloride	U	U	U	U	U	U	U	S	F	
Vinegar			S	D	S	S	S	S		S
Whiskey, Wines	S	S	S	S	S	S	S	S		S
Xylene	U	U	U	U	U	U	U	S	D	U
Zeolities	S							S		S
Zinc Acetate	S		S					S		S
Zinc Chloride or Sulfate	S	S	S	S	S	S		S	S	S

TYPICAL APPLICATIONS



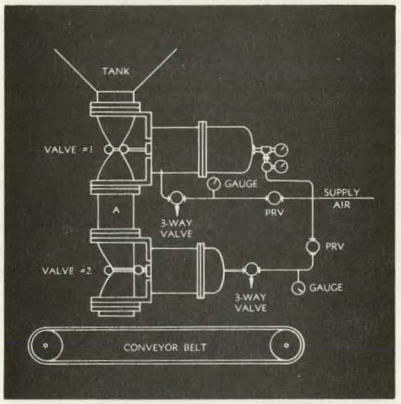
PNEUMATICALLY OPERATED STANDBY PUMPING SYSTEM:

With pump #1 on standby and valve #1 closed, pump #2 is supplying the cyclone header with ore slurry thru a full round opening series "SG" valve, #2. Pump #2 requires maintenance so pump #1 is started with valve #1 still closed. As pump #1 builds up pressure between its outlet and valve #1 the trapped air in the 18" line is relieved thru the small bypass "A" back to the sump. As soon as all air is relieved valve #1 opens and valve #2 closes. By relieving the trapped air thru the bypass the possibility of water hammer, which could damage valve #1 upon opening, is eliminated.



LIQUID LEVEL CONTROL SYSTEM:

The Air-to-Open with Positioner, series "RAF", pinch valve is used to precisely control the level in the tank regardless of the variations in pump output pressure. A vacuum breaker or standpipe, higher than the maximum head of the pump, will eliminate any breathing or fluttering of the pinch valve body due to the hydraulic piston effect creating a vacuum on the downstream side of the valve. This hydraulic piston effect is more prevalent at certain controlled flow capacities than at other capacities and depends on the length, angle, and size of the verticle drop of the valve discharge pipe.

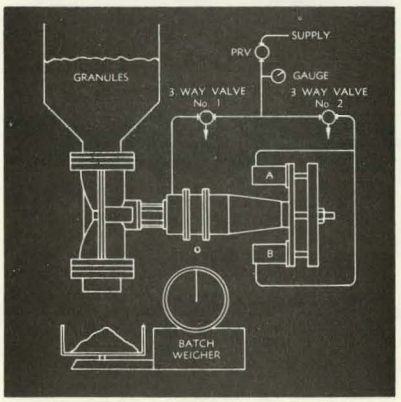


AIR LOCK:

Two RKL air operated type "RAF" valves placed in series are used very satisfactorily as an air lock to unload from a pressure or vacuum tank or when placed above a tank, to load the vessel. There are numerous industrial and chemical applications, one of the most common of which is to replace the rotary valve under a cyclone separator in paper mills.

The system consists of one Air-to-Close valve (#2) and one Air-to-Open, fail Closed, valve (#1) to shut down the line in case of electric or air failure.

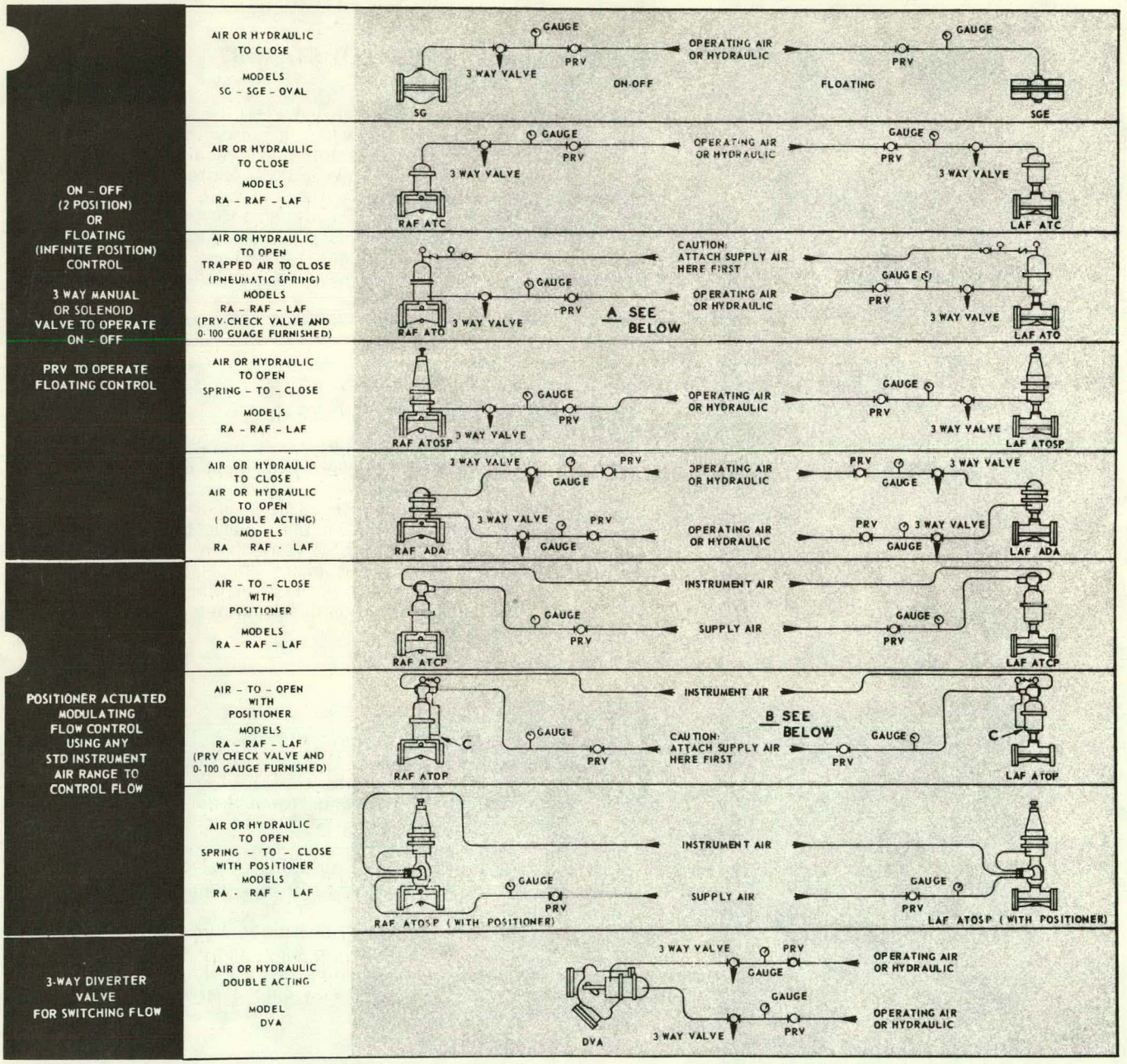
Valve #2 closes ,then Valve #1 opens to admit material, either wet or dry, flowing by gravity into the volume created by spool piece "A". After an interval of time valve #1 closes and valve #2 opens allowing the material to flow onto a conveyor or into an appropriate receiver.



DRIBBLE CONTROL (accuracy ±¼% of full scale)

The batch weigher calls for a new batch which actuates solenoid valve #1 opening the fully enclosed series "L" Air-to-Open Spring to Close (fail closed) RKL Pinch Valve. When 90% of the batch has been weighed in, solenoid valve #2 actuates and extends cylinders "A" and "B". Solenoid valve #1 is then closed and the spring-to-close pinch valve closes to dribble position, as determined by cylinders "A" and "B". At about 99% of batch weight, solenoid valve #2 is closed and cylinders "A" and "B" retract to allow the pinch valve to close tightly.

HOOKUP DIAGRAMS FOR RKL PNEUMATIC OR HYDRAULICALLY OPERATED VALVES

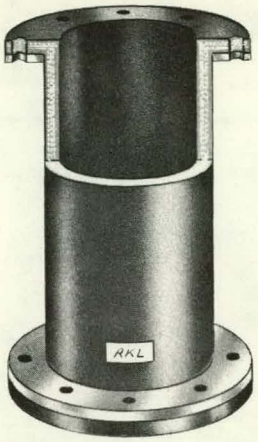


The length of life of a pinch valve varies with the application and is affected primarily by the working pressure, the working temperature, and the duty cycle. Presuming that all of these conditions are satisfactory, that the valve has been properly sized, and that the installation is correct, then we can say that on abrasive service, the life expectancy can be as much as five times as long as other types of valves. On corrosive fluid systems where the correct elastomer has been specified, life expectancy can be equal or greater than other types of valves.

TESTING

Each RKL Pinch Valve, regardless of type, is hydrostatically or pneumatically pressure tested for tight closure and then set to hold a pressure approximately ten percent higher than the maximum working pressure specified on the order, so that the rubber or elastomeric body cannot be overpinched by an operator. Certification of test will be furnished when requested at no additional charge.

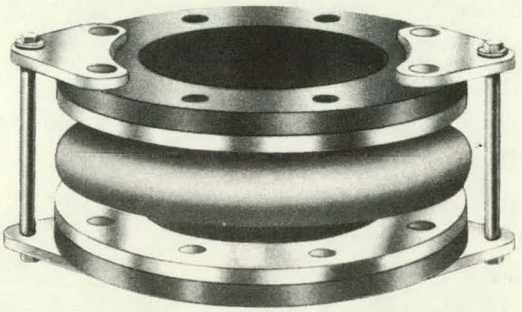
OTHER RKL PRODUCTS



"VIBROSORB" VIBRATION ELIMINATOR
TEFLON* (TFE) LINED OPTIONAL



ELASTOMERIC VIBRATION ISOLATORS

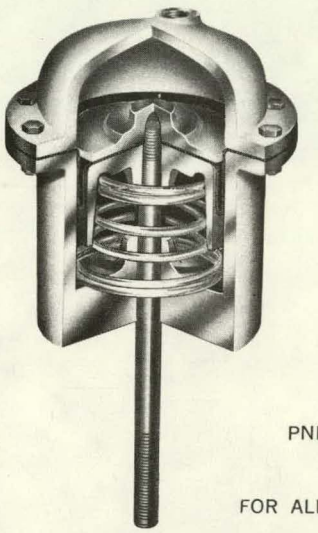


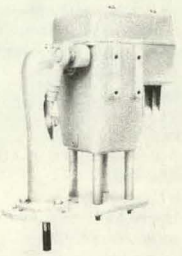
"SPANSORB" EXPANSION JOINT
TEFLON* (TFE) LINED OPTIONAL

RKL ROLLOMOTOR
ROLLING DIAPHRAGM LINEAR ACTUATORS



AIR-TO-EXTEND WITH POSITIONER





ELECTRICALLY OPERATED
WITH SLIDE WIRE

PNEUMATIC — HYDRAULIC — ELECTRIC
ROLLOMOTORS
FOR ALL TYPES OF LONG STROKE LINEAR ACTUATION

HOW TO ORDER

1. Exact model number.
2. Quantity, size, & connection, (flange or slip-on)
3. Body material. Is positive opening feature required?
4. Service conditions.
   - A. Maximum & minimum line pressures through valve.
   - B. Maximum & minimum temperature.
   - C. For vacuum services state in inches of Mercury.
   - D. Acid or Alkali, advise concentration.
   - E. Abrasive, grit size, % solids, wet, dry.
5. Air or Hydraulically operated valves.
   - A. Air or hydraulic pressure to operate (psig).
   - B. Instrument air range (psig).
   - C. Reverse or direct acting positioner.
6. Electrically operated models.
   - A. State operating voltage.
   - B. On-off or modulating service.

RKL®

RKL CONTROLS, INC.

ARK ROAD, LUMBERTON, NEW JERSEY 08048 • PHONE (609) 267-2800 • TELEX 831-692

* DUPONT TRADEMARK

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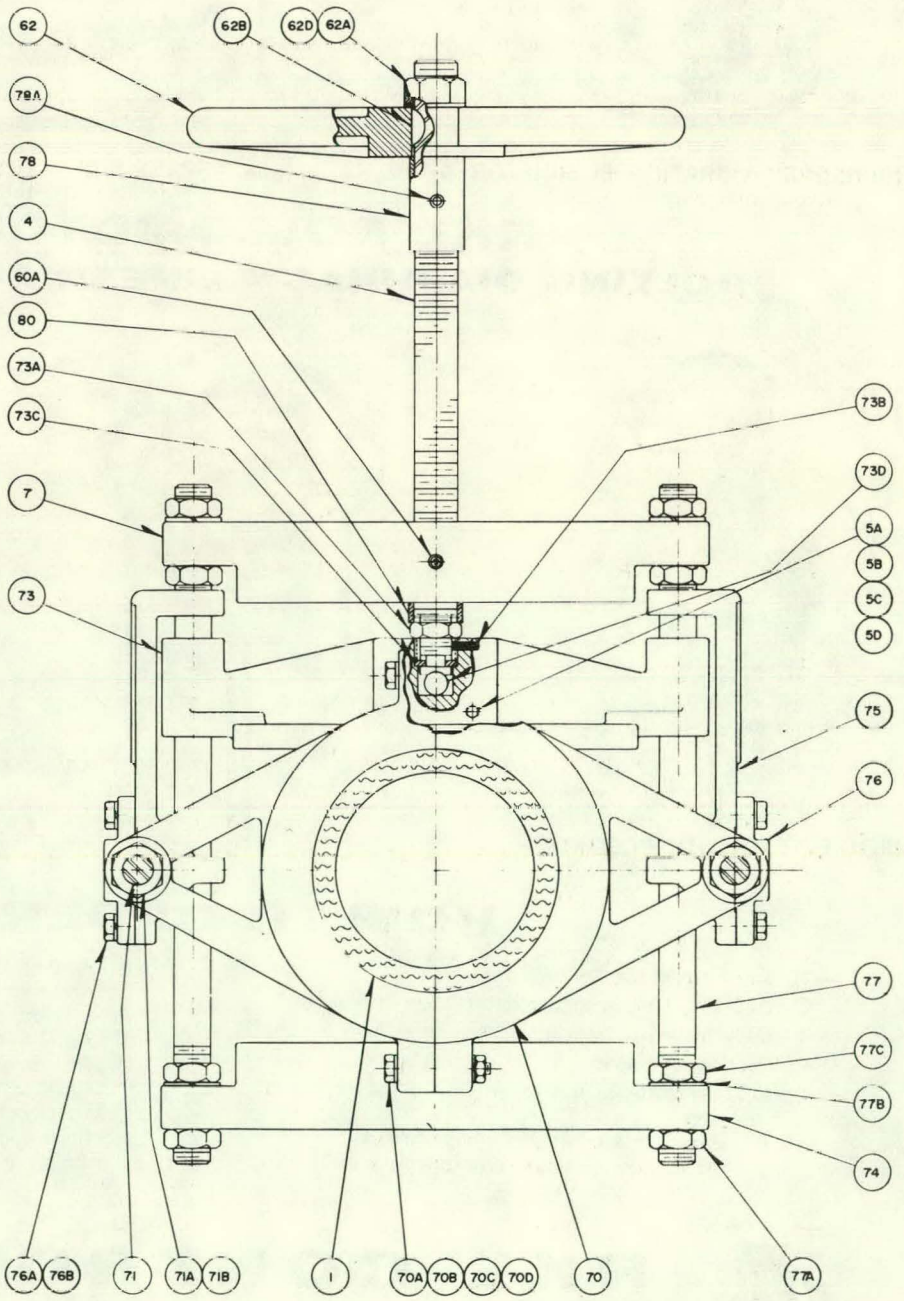
PRINTED IN U.S.A.

RKL CONTROLS

Model KSR
Open Construction, Full Round, Manually Operated

D80033

ITEM	DESCRIPTIONS	REQ'D
1	BODY	1
4	STEM	1
5A	BOLT, P.O.F.	4
5B	LOCK WASHER, P.O.F.	4
5C	WASHER, P.O.F.	4
5D	NUT, P.O.F.	4
7	YOKE	1
60A	GREASE FITTING	1
62	HAND WHEEL	1
62A	RETAINING NUT, H.W.	1
62B	KEY, H.W.	1
62D	LOCK WASHER, RETAINING NUT-H.W.	1
70	FLANGE ASS'Y.	2
70A	BOLT, FLANGE ASS'Y	8
70B	LOCK WASHER, FLANGE ASS'Y.	8
70C	WASHER, FLANGE ASS'Y.	8
70D	NUT, FLANGE ASS'Y	8
71	TIE-ROD, FLANGE ASS'Y.	2
71A	NUT, TIE-ROD	8
71B	LOCK WASHER, TIE-ROD	4
73	UPPER PINCH BAR	1
73A	STEM RETAINER	1
73B	SET SCREW, STEM RETAINER	1
73C	"C" WASHER, STEM-UPPER PINCH BAR	1
73D	THRUST BALL, STEM-UPPER PINCH BAR	1
74	LOWER PINCH BAR	1
75	SIDE FRAME	2
76	SIDE PLATE	2
76A	BOLT, SIDE PLATE	8
76B	LOCK WASHER, SIDE PLATE	8
77	GUIDE ROD	2
77A	NUT, GUIDE ROD	4
77B	LOCK WASHER, GUIDE ROD	4
77C	JAM NUT, GUIDE ROD	4
78	H.W. COLLAR	1
78A	SPRING PIN, H.W. COLLAR	1
80	STEM COLLAR	1



KSR - HW

INSTALLATION & MAINTENANCE

THE SERIES K (HANDWHEEL OPERATED) RKL PINCH VALVE IS COMPLETELY ASSEMBLED AND AND READY TO INSTALL.

1. BE SURE THE LENGTH OF PIPE LEFT OUT TO RECEIVE THE VALVE IS FOUR (4) TIMES THE NOMINAL PIPE DIAMETER FOR VALVE SIZES ½" THRU 4" AND THREE (3) TIMES THE NOMINAL PIPE DIAMETER FOR VALVES SIZES 6" AND LARGER.

2. THE VALVE MAY BE MOUNTED IN ANY POSTITON WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL THE VALVE NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED.

3. MAKE SURE THE PIPE ENDS THAT ARE INSERTED INTO THE RUBBER BODY ARE FREE OF ANY BURRS, PIPE THREADS, OR PIPE WRENCH MARKS. THESE ENDS MUST BE SMOOTH FOR A TIGHT CONNECTION.

4. TO INSTALL THE VALVE, LOOSEN THE HOSE CLAMPS AND THE FOUR CLAMPING BOLTS (19 ON THE ATTACHED PRINT), AND INSERT YOUR PIPE IN BOTH ENDS UNTIL THE PIPE BUTTS UP AGAINST THE SHOULDERS INSIDE THE VALVE BODY. CLOSE THE VALVE, THEN RETIGHTEN THE FOUR CLAMPING BOLTS AND THE TWO HOSE CLAMPS.

MAINTENANCE

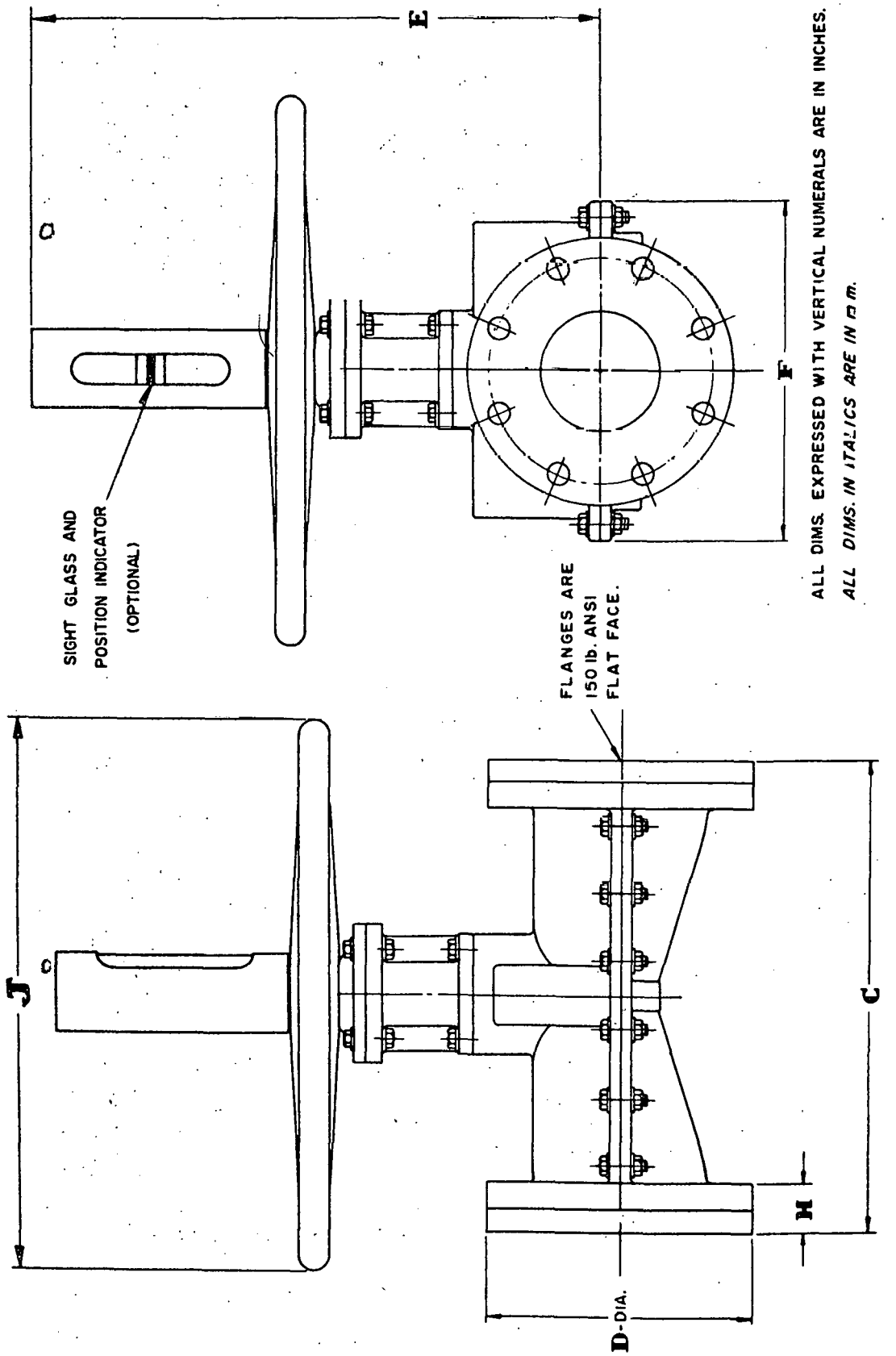
GREASE THE STEM OCCASIONALLY (#6 ON THE ATTACHED PRINT) TO PREVENT THREAD WEAR. NO OTHER MAINTENANCE IS REQUIRED AS THERE ARE NO PACKING GLANDS OR OTHER MOVING PARTS THAT REQUIRE GREASE OR OIL.

IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTEES AND WARRANTIES WILL BE VOID.

RKL CONTROLS
ROBBINS & MYERS, INC.
BOX 276, ARK RD.
LUMBERTON, N.J. 08048
ph: 609-267-2800
telex: 831-692

REVISED: MAY 15, 1967

Model LHW
Enclosed, Pre-Pinched, Manually Operated



VALVE SIZE	1		1½		2		2½		3		4		5		6		8		10		12		14		16	
C	6	152	6	152	8	203	10	254	12	305	15	406	15	381	18	457	24	610	30	762	35	914	42	1067	45	1143
D	4¼	108	5	127	6	152	7	178	9½	191	9	229	10	254	11	279	13½	343	16	406	19	483	21	533	23½	597
E	6⅞	175	7⅛	181	7⅜	187	8⅝	219	8⅞	225	10⅝	268	12¹⁹/₃₂	320	13³/₃₂	333	7 1³/₁₆	198	9 ½	241	11 ⅝	295	13	330	14 ⅛	359
F	5¼	133	6 ⅛	156	7	178	8 ⅞	225	12 ¼	260	12 ⅛	300	13¼	337	15⅞	403	18 ¾	476	22 ½	571	27	686	29	737	33¾	857
H	1 1/16	27	1⅛	29	1 1/16	37	1½	38	⅝	40	1 1/16	43	1¾	44	1 1/16	48	2 1/8	54	2 1/16	62	2¾	70	3	76	3¾	96
J	6	152	6	152	7	178	7¾	197	7¾	197	10	254	12	305	14	356	16	406	20	508	24	610	28	711	32	813

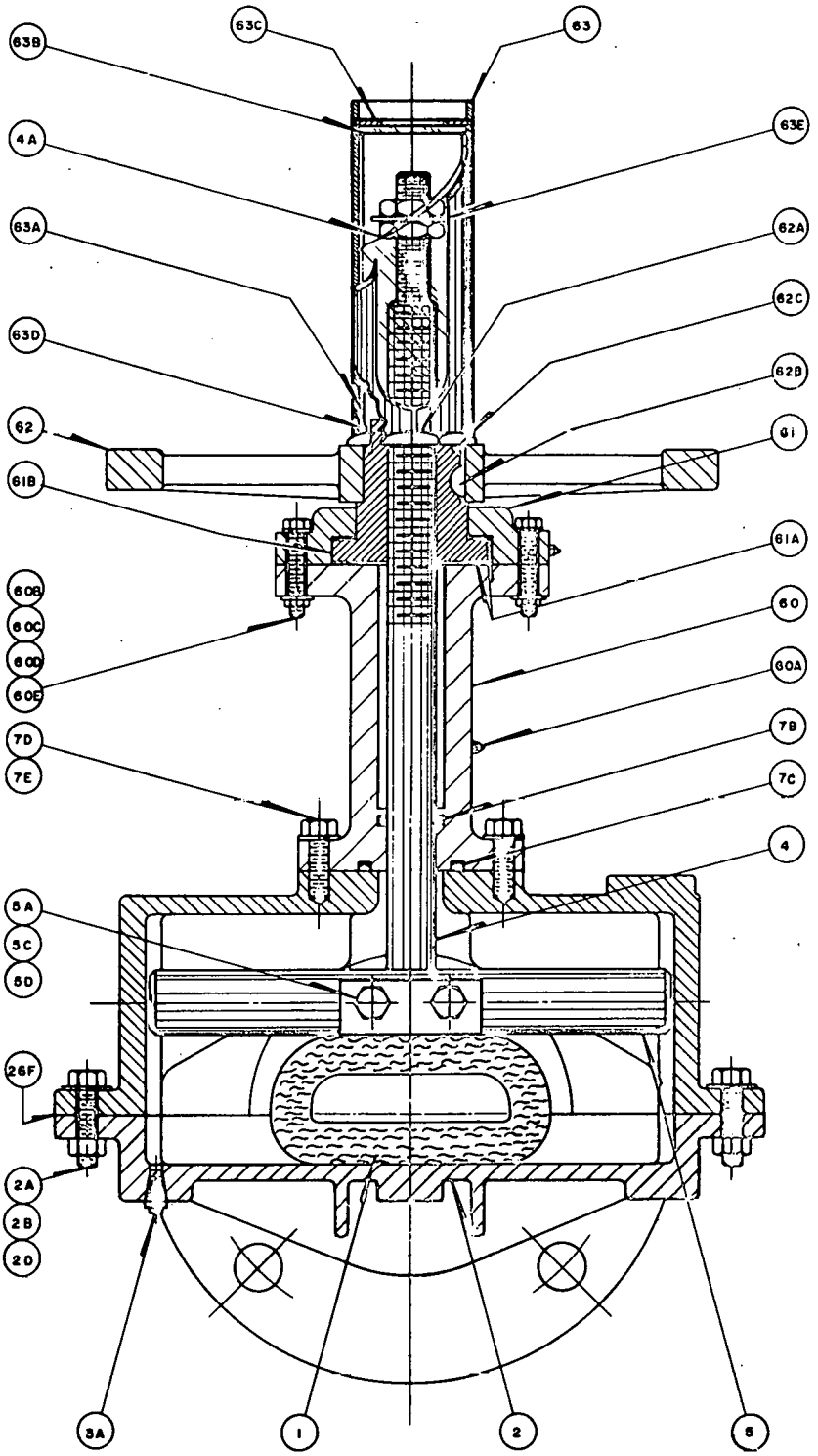
RKL CONTROLS

Model LHW
Enclosed, Pre-Pinched
Manually Operated

D80023

ITEM	DESCRIPTIONS	REQ'D	
1.	BODY	1	
2.	BONNET ASS'Y.	1	
2A.	BOLT, BONNETS	*	
2B.	LOCK WASHER, BONNETS	*	
2D.	NUT, BONNETS	*	
3A.	PLUG, LOWER BONNET	1	
4.	STEM, VALVE	1	
4A.	MECHNICAL STOP, VALVE	2	
5.	PINCH BAR	1	
5A.	BOLT, P.O.F.	2	
5C.	WASHER, P.O.F.	4	
5D.	NUT, P.O.F.	2	
7B.	"O"-RING, SPOOL-STEM	1	
7C.	"O"-RING, SPOOL-BONNET	1	
60.	SPOOL	1	
60A.	GREASE FITTING	2	
60B.	BOLT, SPOOL-CAP	4	
60C.	LOCK WASHER, SPOOL-CAP	4	
60D.	WASHER, SPOOL-CAP	4	
60E.	NUT, SPOOL-CAP	4	
61.	SPOOL CAP	1	
61A.	NYLATRON WASHER	2	
61B.	BRASS NUT	1	
62.	HANDWHEEL	1	
62A.	RETAINING NUT, H.W.	1	
62B.	KEY, H.W.-BRASS NUT	1	
63.	SHEILD	*	*
63A.	LINER TUBE, SHEILD	*	*
63B.	COVER, LINER TUBE	*	*
63C.	RETAINING RING, LINER TUBE	*	*
63D.	"O"-RING, LINER TUBE	*	*
63E.	POSITION RING	*	*
62C.	LOCKING RING, HANDWHEEL	1	
7D.	BOLT, SPOOL-BONNET	4	
7E.	LOCK WASHER, SPOOL-BONNET	4	
26F.	SEALANT	A/R	

* ..... SEE CHART BELOW * * ..... OPTIONAL



ITEM	QUANTITY															
	PINCH VALVE BONNET															
	1	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24
2A 2B 2D	6	8	10	10	10	12	14	14	14	18	18	18	28	32	32	32

RKL CONTROLS
ROBBINS & MYERS INC., Lumberton, NJ 08048
TELEX: 831-692
(609) 267-2800

THE MODEL LHW (HANDWHEEL OPERATED) RKL PINCH VALVE IS COMPLETELY ASSEMBLED, PRESSURE TESTED CONFORMING TO YOUR PRESSURE AND TEMPERATURE SPECIFICATIONS AND IS READY FOR INSTALLATION.

1. THE VALVE MAY BE MOUNTED IN ANY POSITION WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED UNLESS valve WAS SPEICFIED FOR HOT SERVICE.

2. CLEAN YOUR METAL MATING FLANGES OF ALL OLD GASKETS AND ANY DIRT.

3. COAT VALVE'S RUBBER FLANGES WITH A PASTE SOLUTION OF GRAPHITE AND GLYCERINE OR SILICONE GREASE. IF THESE ARE NOT READILY AVAILABLE, USE SOAPY WATER. THIS ENABLES YOU TO INSTALL EASIER AND MAY SAVE YOU DIFFICULTY IN PARTING FLANGES AT A LATER DATE.

4. CLOSE THE VALVE WHILE IT IS BEING INSTALLED.

5. MAKE SURE THAT THE PIPE LINE ON ONE SIDE OF THE VALVE HAS ENOUGH PLAY IN IT SO THAT THE PIPE FLANGE CAN BE DRAWN UP TO THE VALVE, AS THE VALVE WILL NOT STRETCH AND THERE MUST BE ENOUGH PLAY TO TAKE CARE OF THE COMPRESSIBILITY OF THE ELASTOMERIC FLANGE. IF THE PIPE LINE IS SOLIDLY ANCHORED ON BOTH SIDES, THEN A FLEXIBLE JOINT, SUCH AS AN RKL VIBROSORB OR SPANSORB MUST BE USED IN THE PIPE LINE TO CREATE PLAY.

6. INSERT THE VALVE. PULL UP EQUALLY AND FIRMLY ON THE FLANGE BOLTS. AFTER IN SERVICE FOR 24 HRS, PULL UP FIRMLY ON FLANGE BOLTS AGAIN. THIS IS TO ELIMINATE ANY LEAKAGE DUE TO AN ELASTOMERIC SET TAKING PLACE.

GENERAL MAINTENANCE

LUBRICATE THE VALVE STEM ONLY EVERY 2,000 CYCLES; MORE OFTEN IF NOT CYCLED AS MUCH. AN ALEMITE FITTING IS SUPPLIED IN THE SPOOL FOR THIS PURPOSE.

DO NOT USE A BAR (CHEATER) THRU THE HANDWHEEL TO TIGHTEN THE VALVE CLOSURE AS OVERTORQUE CAN DAMAGE THE BRASS STEM NUT.

THE TWO LOCK NUTS ON THE END OF THE RISING STEM HAVE BEEN ADJUSTED UNDER ACTUAL PRESSURE CONDITIONS TO GIVE YOU TIGHT SHUT OFF FOR YOUR PARTICULAR PRESSURE CONDITIONS AND IN THEIR SET POSITION, PREVENT OVER PINCHING OF THE RUBBER PINCH VALVE BODY. ONLY ADJUST ½ TURN AT A TIME, OR CONSULT THE FACTORY.

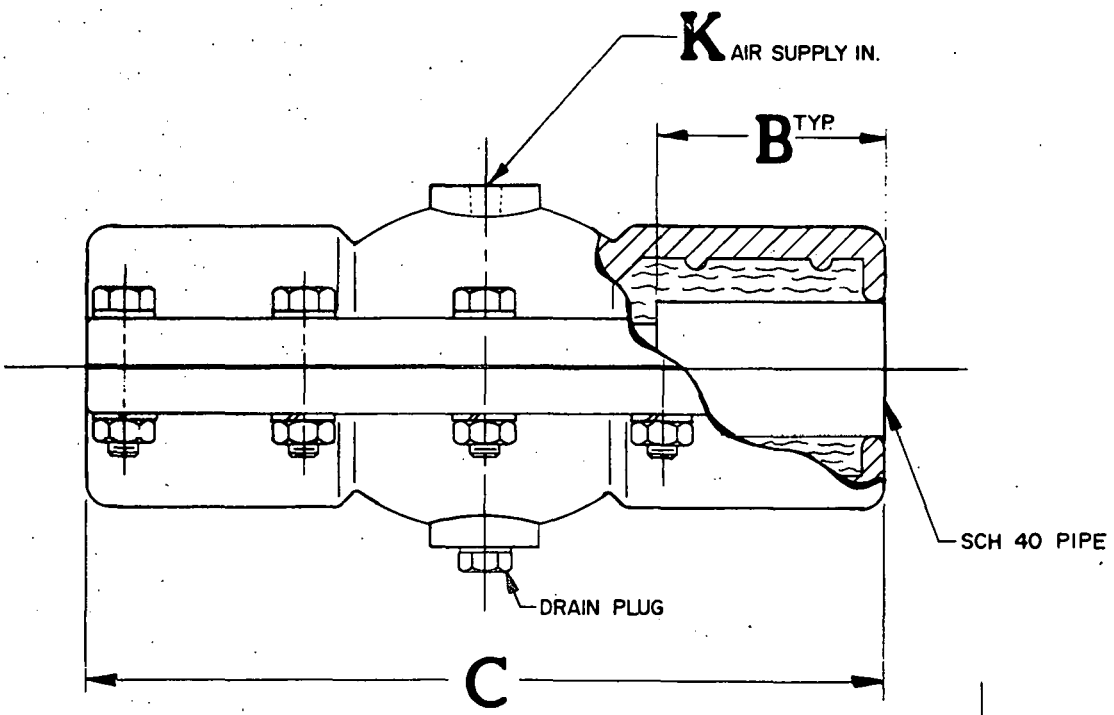
IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTIES AND WARRANTIES WILL BE VOID.

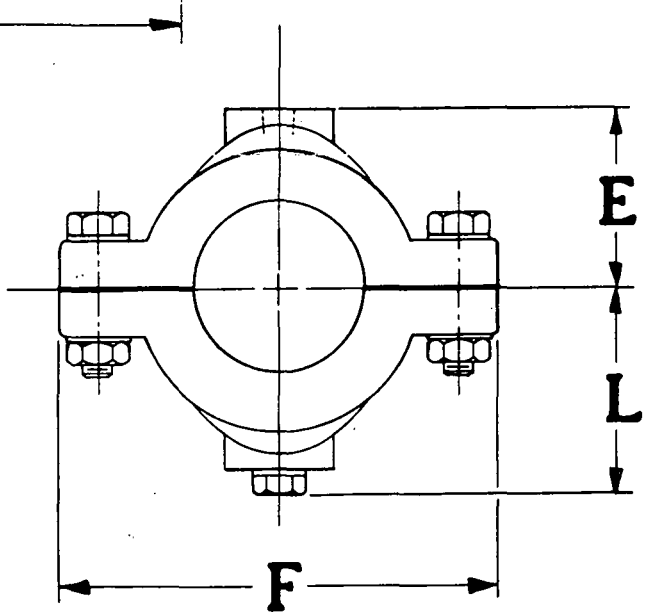
IF ANY TROUBLE IS ENCOUNTERED DURING THE INSTALLATION OF THIS VALVE CALL:

RKL CONTROLS
ROBBINS & MYERS
P.O. BOX 276, ARK RD.
LUMBERTON, N,J. 08048
PH: 609-267-2800, TELEX: 831-692

RKL CONTROLS

Model SGE
Enclosed, Full Round,
No Actuator required





Fails: Open

NOTE: ALL DIMENSIONS ARE IN INCHES.

VALVE SIZE	1/4	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
B DIM.	1-7/16	1-11/16	1-13/16	2-3/32	2-1/2	3	3-1/8	3-5/8	4-1/8	5-1/8
C DIM.	4-7/8	5-3/4	6-3/8	7-3/16	8-1/2	10-1/4	11-3/4	14-1/4	16-1/4	20-1/4
E DIM.	1-1/16	1-1/4	1-7/16	1-11/16	2	2-3/16	2-5/8	3-3/16	3-5/8	4-5/8
F DIM.	2-3/4	3-1/4	3-1/2	4-1/8	4-1/2	4-3/4	5-1/2	6-5/8	7-1/2	8-3/4
K PORTS	1/8 NPT	1/8 NPT	1/8 NPT	1/4 NPT	1/4 NPT	1/4 NPT	1/4 NPT	1/4 NPT	1/4 NPT	1/4 NPT
L DIM.	1-3/8	1-9/16	1-3/4	2	2-5/16	2-1/2	2-15/16	3-1/2	4	5

RKL CONTROLS

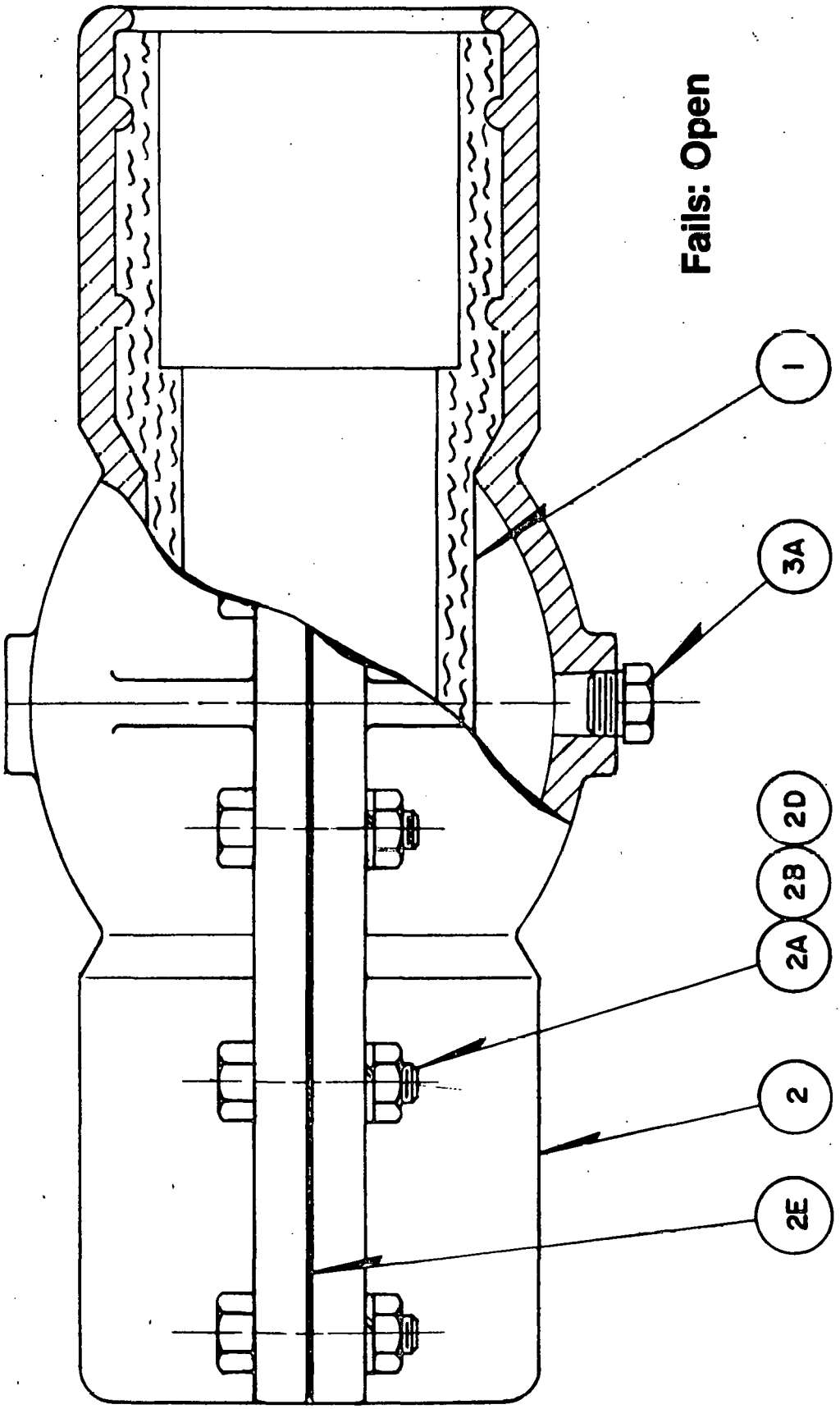
Model SGE
Enclosed, Pre-Pinched
No Actuator required

C80031

ITEM	DESCRIPTIONS	REQ'D
1.	BODY	1
2.	BONNET ASSEMBLY	1
2A.	BOLT, BONNET ASS'Y	*
2B.	LOCK WASHER, BONNET ASS'Y	*
2D.	NUT, BONNET ASS'Y	*
2E.	GASKET, BONNET ASS'Y	2
3A.	PLUG, BONNET ASS'Y	1

* . . . SEE "CHART" FOR QUANTITY

QUANTITY		SGE PINCH VALVE BONNETS								
ITEM	1/4	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
2A	8	10	0	10	10	12	12	16	16	20
2B										
2D										



THE SERIES SGE (SLIP-ON CONNECTIONS, AIR OPERATED) PINCH VALVE HAS BEEN COMPLETELY ASSEMBLED AND TESTED TO CONFORM TO THE CONDITIONS OF YOUR APPLICATION.

1. THE VALVE MAY BE MOUNTED IN ANY POSITION WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED UNLESS VALVE WAS SPECIFIED FOR HOT SERVICE.

2. MAKE SURE THE PIPE ENDS THAT ARE INSERTED INTO THE RUBBER BODY ARE FREE FROM ANY BURRS, THREADS, OR PIPE WRENCH MARKS, THESE ENDS MUST BE SMOOTH AND CLEAN FOR A TIGHT CONNECTION.

3. TO INSTALL VALVE, LOOSEN THE BOLTS AND REMOVE THE VALVE HOUSING. INSERT YOUR PIPE IN BOTH ENDS OF THE RUBBER VALVE BODY UNTIL THE PIPE BUTTS UP AGAINST THE SHOULDERS INSIDE THE VALVE BODY (IF NECESSARY, MEASURE TO INSURE PROPER INSERTION).

4. AFTER INSERTING PIPE, BOLT THE HOUSING HALVES TOGETHER, THE YELLOW LINE MARKED ON THE OUTSIDE OF THE RUBBER VALVE BODY SHOULD BE ALIGNED WITH THE SEAM WHERE THE HALVES OF THE HOUSING MEET (EITHER SIDE IS ACCEPTABLE).

5. ATTACH AIR SUPPLY AT CONNECTION IN TOP OF VALVE HOUSING.

6. USE ONLY CLEAN, DRY, NON-LUBRICATED AIR OR SPECIFIED HYDRAULIC FLUID TO OPERATE THE VALVE.

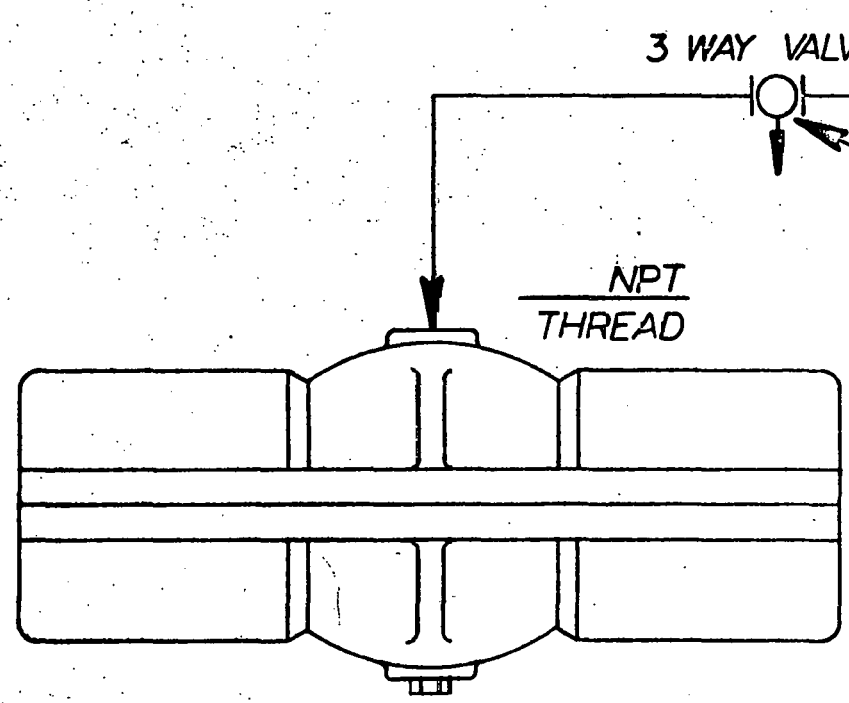
7. DO NOT APPLY MORE PRESSURE THAN SPECIFIED TO OPERATE THE VALVE. USE A PRESSURE REDUCING VALVE WITH A BUILT-IN RELIEF PORT TO REDUCE YOUR PLANT AIR PRESSURE, IF NECESSARY.

8. FOLLOW SAME PROCEDURE AS OUTLINED ABOVE WHEN INSTALLING REPLACEMENT RUBBER VALVE BODIES.

CAUTION: IF THIS VALVE IS INSTALLED AFTER A PUMP, BE SURE IT IS FULLY OPEN BEFORE STARTING THE PUMP, OR RELIEVE THE AIR PRESSURE BETWEEN THE VALVE AND PUMP BEFORE OPENING THE VALVE TO PREVENT DAMAGE TO THE RUBBER LINER DUE TO HYDRAULIC HAMMER.

QUESTIONS REGARDING INSTALLATION OF NEW VALVES OR REPLACEMENT BODIES, OR PROPER OPERATION OF THE VALVE, SHOULD BE REFERRED TO THE CUSTOMER SERVICE DEPARTMENT AT THE FOLLOWING ADDRESS:

RKL CONTROLS
ROBBINS & MYERS, INC.
P.O. BOX 276, ARK RD.
LUMBERTON, N.J. 08048
PH: 609-267-2800
TELEX: 831-692



VALVE SIZE	
END CONNECTION	
BODY MATERIAL	
MAX. TEMP.	
LINE PRESSURE	

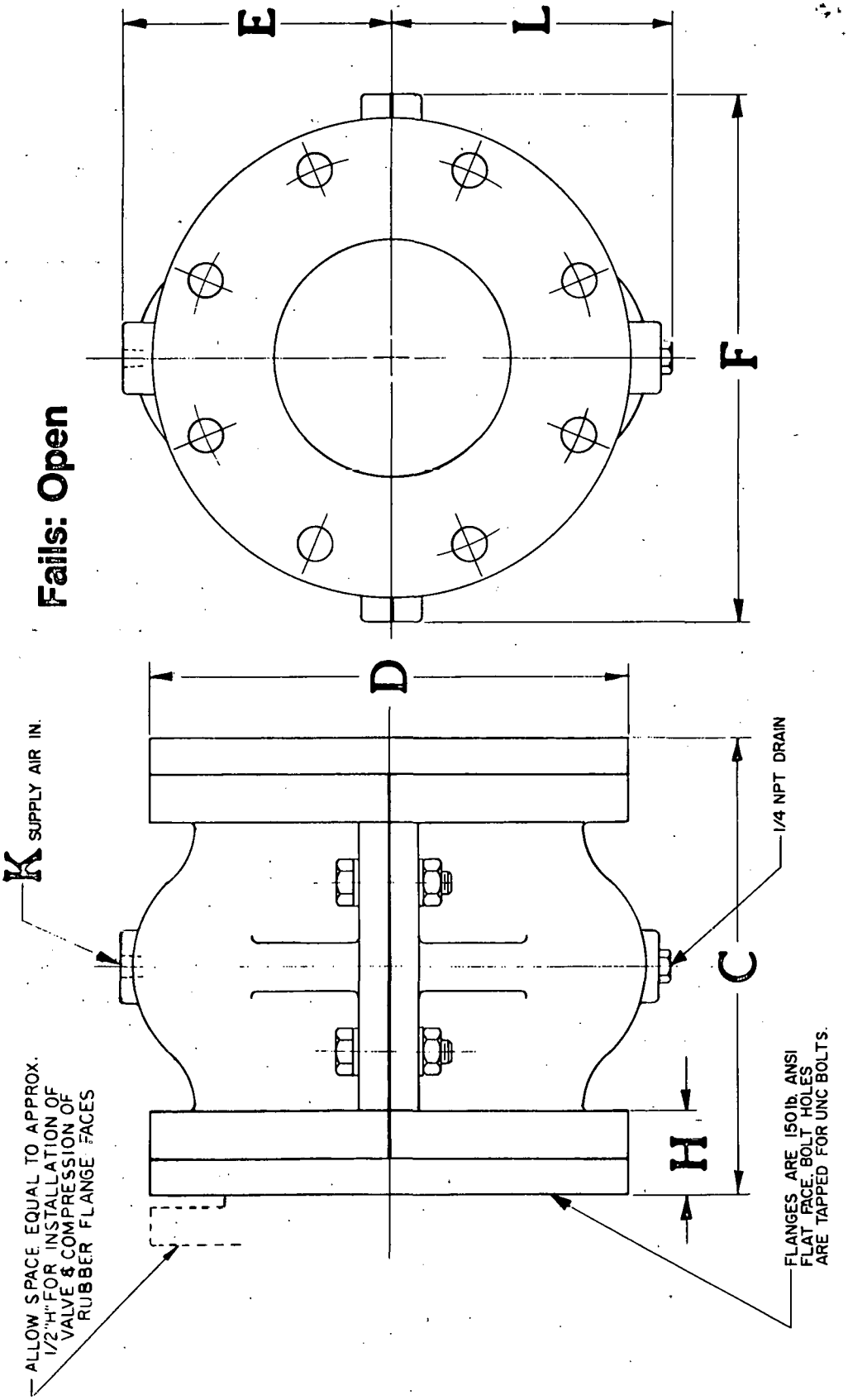
AIR HOOKUP DIAGRAM FOR SERIES 'SGE' VALVES

RKL CONTROLS, INC.
HAINESPORT INDUSTRIAL PARK
HAINESPORT, N.J.

RKL CONTROLS

Model SG
Enclosed, Full Round,
No Actuator required

C40047



ALL DIMENSIONS ARE IN INCHES.

VALVE SIZE	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24	30
C-DIM	4	4-5/16	4-3/4	5-1/4	5-3/4	6	8	10	12	16	20	24	28	32	36	40	48	60
D-DIA.	4-1/4	4-5/8	5	6	7	7-1/2	9	10	11	13-1/2	16	19	21	23-1/2	25	27-1/2	32	38-3/4
E-DIM.	2-3/4	2-5/8	3-1/4	3-1/4	3-3/4	4-1/4	5	5-7/8	7	8-3/4	10-1/2	11-3/4	13-5/8	15-1/4	16-3/8	18-3/4	24	31
F-DIM.	4-1/4	5-1/4	5-1/8	6-1/4	7	7-1/2	9-3/4	11	11-1/2	14-1/2	17	20	22-1/2	24-1/4	26-1/2	29-1/2	36	45
H-DIM.	1	1-1/8	1-1/8	1-1/4	1-1/4	1-1/2	1-3/4	2	2-1/8	2-3/8	2-5/8	2-3/4	3-3/8	3-1/2	3-5/8	4-1/4	4-3/4	5-1/4
K-PORT	1/4 NPT							1/2 NPT			3/4 NPT			1 NPT				
L-DIM	3	2-7/8	3-1/2	3-1/2	4	4-1/2	5-1/4	6-1/8	7-1/4	9	10-3/4	12	13-7/8	15-1/2	16-5/8	19	24-1/4	31-1/4

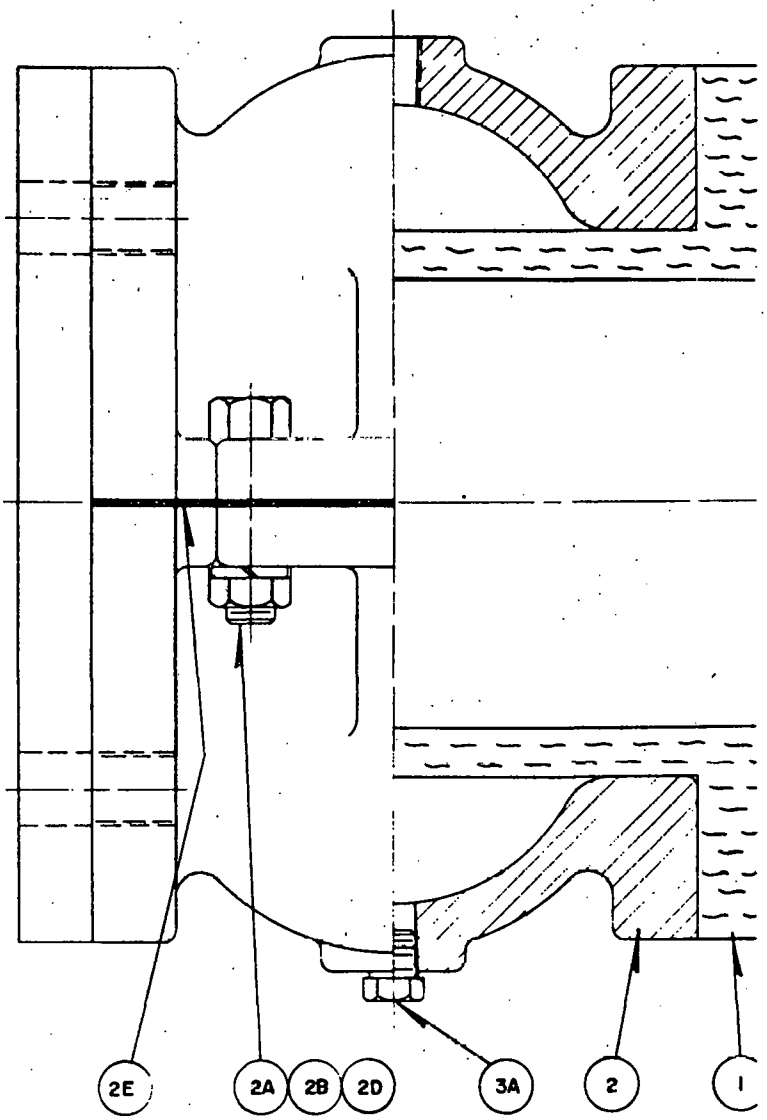
RKL CONTROLS

Enclosed, Pre-Pinched
No Actuator required

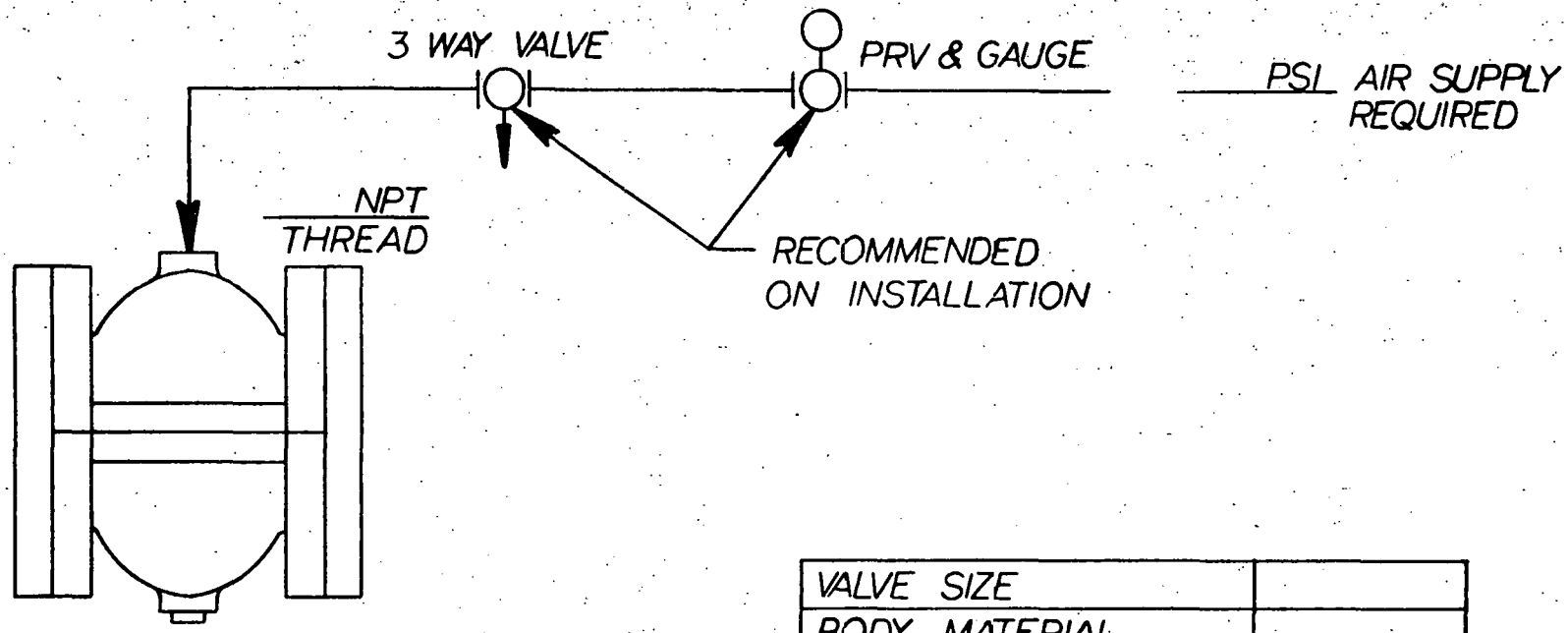
ITEM	DESCRIPTIONS	REQ'D
1	BODY	1
2	BONNET ASSEMBLY	1
2A	BOLT, BONNET ASS'Y	*
2B	LOCK WASHER, BONNET ASS'Y	*
2D	NUT, BONNET ASS'Y	*
2E	GASKET, BONNET ASS'Y	2
3A	PLUG, BONNET ASS'Y	1

* . . *SEE "CHART" BELOW FOR QUANTITY.*

Fails: Open



QUANTITY															
SG PINCH VALVE BONNETS															
ITEM	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18
2A 2B 2D	4	4	4	4	4	4	4	4	8	10	10	12	16	16	18



VALVE SIZE	
BODY MATERIAL	
MAX. TEMP.	
LINE PRESSURE	

AIR HOOKUP DIAGRAM FOR SERIES 'SG' VALVES

RKL CONTROLS, INC.
HAINESPORT INDUSTRIAL PARK
HAINESPORT, N.J.

INSTALLATION AND MAINTENANCE INSTRUCTIONS
(REPLACEMENT OF HOUSING GASKETS AND VALVE BODIES)

1. THIS VALVE IS RECEIVED FROM THE FACTORY READY FOR INSTALLATION AND AIR OR HYDRAULIC HOOK-UP AS PER THE ATTACHED HOOK-UP DIAGRAM. THIS VALVE HAS BEEN THOROUGHLY TESTED FOR TIGHTNESS BEFORE SHIPMENT.

2. USE A LUBRICANT NOT HARMFUL TO RUBBER ON THE FACE OF THE FLANGES BEFORE INSTALLING THE VALVE.

3. USE ONLY CLEAN, DRY, NON-LUBRICATED AIR OR SPECIFIED HYDRAULIC FLUID TO OPERATE THE VALVE.

4. DO NOT APPLY MORE PRESSURE THAN SPECIFIED ON THE HOOKUP DIAGRAM, USING A PRESSURE REDUCING VALVE AS SHOWN, IF NECESSARY.

REPLACEMENT OF GASKETS AND BODY

1. IF GASKETS NEED REPLACING, REMOVE THE VALVE FROM THE LINE AND SEPARATE THE VALVE HOUSING BY REMOVING BOLTS AND NUTS NO.3 AND 5 AS SHOWN ON DRAWING IGS-722C.

2. CLEAN GASKETED SURFACES COMPLETELY AND APPLY NEW GASKETS.

3. WHEN INSTALLING NEW RUBBER BODY, COAT THE BACK OF THE NEW BODY FLANGES FOR AT LEAST 2" ALONG THE SPOOL OF THE BODY FROM EITHER END WITH A GLYCERINE AND WATER SOLUTION, VASOLENE, OR OTHER LUBRICANT, WHICH WILL NOT ATTACK RUBBER. (SILICONE GREASE MAY ALSO BE USED.)

4. INSERT NEW BODY IN ONE VALVE HOUSING HALF, ALLOWING AN EQUAL AMOUNT TO STICK OUT OF EITHER END. BE SURE TO ALIGN THE BOLT HOLES IN THE RUBBER BODY WITH THE THREADED HOLES IN THE HOUSING.

5. PLACE OTHER HALF OF THE VALVE HOUSING OVER THE RUBBER BODY AND BOLT THE TWO HALVES TOGETHER WITH NEW GASKETS, #6 ON PRINT IGS-722C.

6. TIGHTEN THE HOUSING BOLTS TIGHTLY AND TRIM THE EXCESS GASKET FLUSH WITH THE CASTING ON BOTH SIDES AND ENDS OF THE VALVE.

7. COAT THE FACE OF THE RUBBER FLANGES WITH A LUBRICANT NON-HARMFUL TO RUBBER SUCH AS A SOLUTION OF GLYCERINE AND WATER OR VASOLENE.

8. FOLLOW THE INSTRUCTIONS ABOVE FOR INSTALLATION OF THE VALVE.

CAUTION: IF THIS VALVE IS INSTALLED AFTER A PUMP, BE SURE IT IS FULLY OPEN BEFORE STARTING THE PUMP OR RELIEVE THE AIR PRESSURE BETWEEN THE VALVE AND PUMP BEFORE OPENING THE VALVE TO PREVENT DAMAGE TO THE RUBBER LINER DUE TO HYDRAULIC HAMMER.

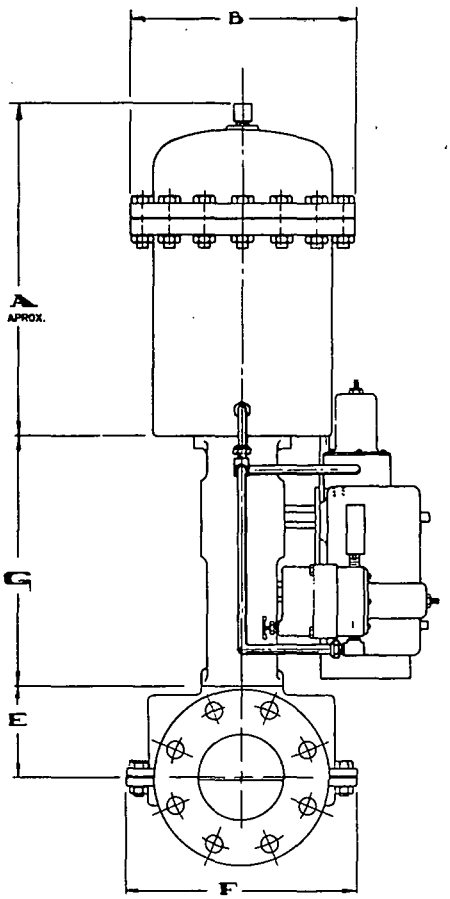
IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTEES AND WARRANTIES WILL BE VOID. IF YOU HAVE ANY QUESTIONS WHEN INSTALLING A VALVE OR REPLACING A VALVE BODY, CALL OUR PLANT DIRECTLY.

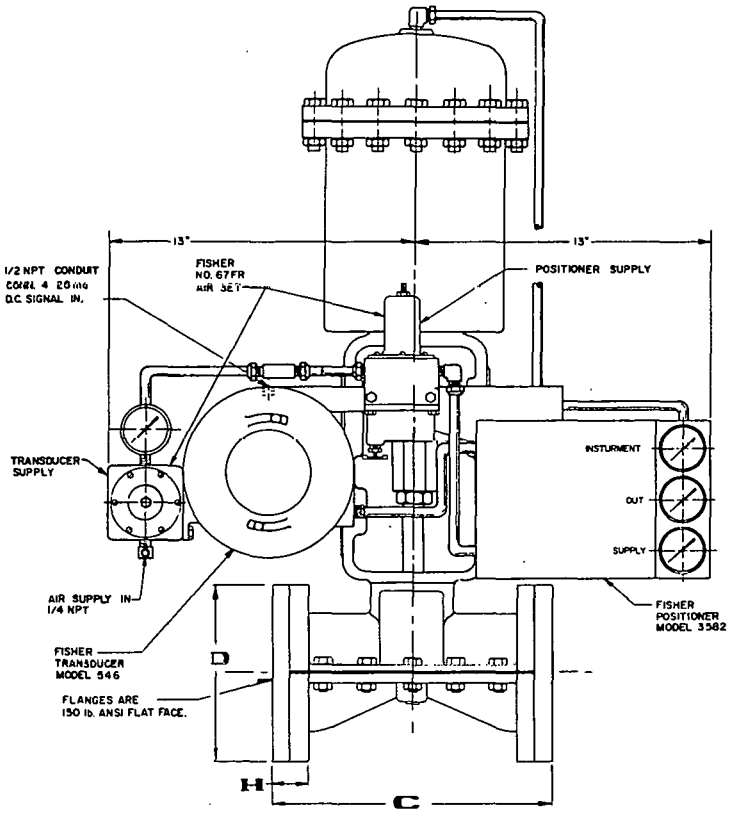
RKL CONTROLS
ROBBINS AND MYERS, INC.
P.O. BOX 276, ARK RD.
LUMBERTON, N.J. 08048
PH: 609-267-2800 TELEX: 831-692

RKL CONTROLS

Model LAF-ATC-OY
Enclosed, Pre-Pinched,
Fisher I/P Transducer and Positioner

D40064





ACTUATOR SIZE	14	26	35	47	60	100	150	235
A DIMENSION	7-3/4	10-5/8	6	16-3/8	13-3/8	17	21-1/2	32-1/4
B DIAMETER	6-3/4	8-3/8	12	10-1/2	11-3/4	14-3/4	18-1/2	22-1/2

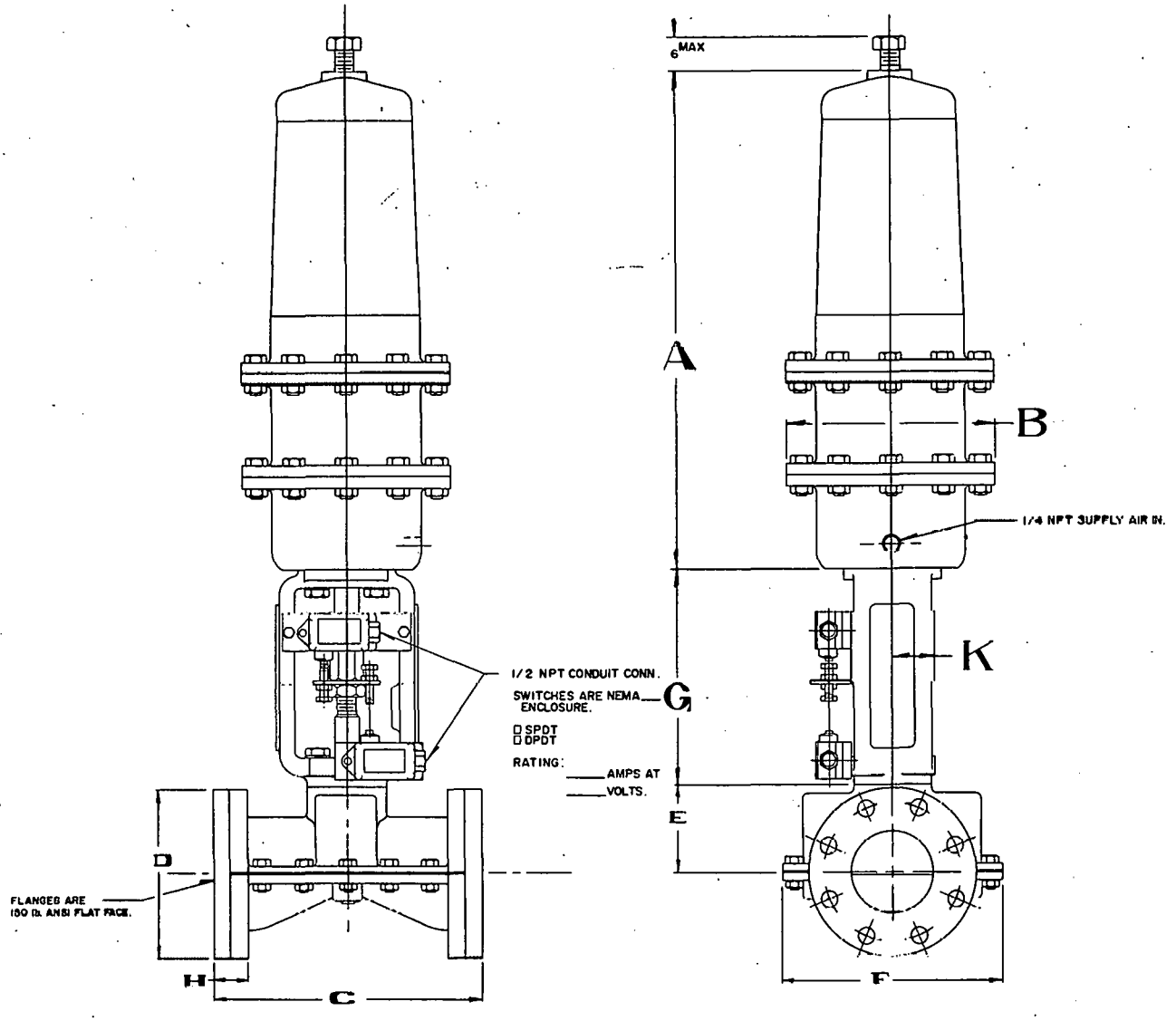
Fails: Open

NOTE: ALL DIMENSIONS ARE IN INCHES.

VALVE SIZE	1	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18		
C DIMENSION	6	6	8	10	12	16	15	18	24	30	36	42	45	50-1/4		
D DIAMETER	4-1/4	5	6	7	7-1/2	9	10	11	13-1/2	16	19	21	23-1/2	25		
E DIMENSION	2-7/16	2-5/8	3	3-9/16	3-13/16	4-15/16	5-1/2	6	7-13/16	9-1/2	11-5/8	13	14-1/8	16-3/4		
F DIMENSION	5-1/2	6-1/8	7	8-7/8	10-1/4	12-1/8	13-1/4	15-7/8	18-3/4	22-1/2	27	29	33-3/4	39-1/2		
G DIMENSION	8-7/8	8-7/8	8-7/8	10-11/16	10-11/16	13-13/16	13-13/16	13-13/16	19-1/2	19-1/2	20	20	20	20		
H DIMENSION(THK)	1-1/16	1-1/8	1-7/16	1-1/2	1-9/16	1-11/16	1-3/4	1-7/8	2-1/8	2-7/16	2-3/4	3	3-3/4	3-3/4		

RKL CONTROLS

Enclosed, Pre-Pinched, Limit Switches



ACTUATOR SIZE	14	26	35	60	100	150	186
A DIMENSION	19	22-3/4	17-3/8	30-7/8	39-3/4	60-1/4	61-1/2
B DIAMETER	6-3/4	8-3/8	12	11-3/4	14-3/4	18-1/2	19

Fails: Closed

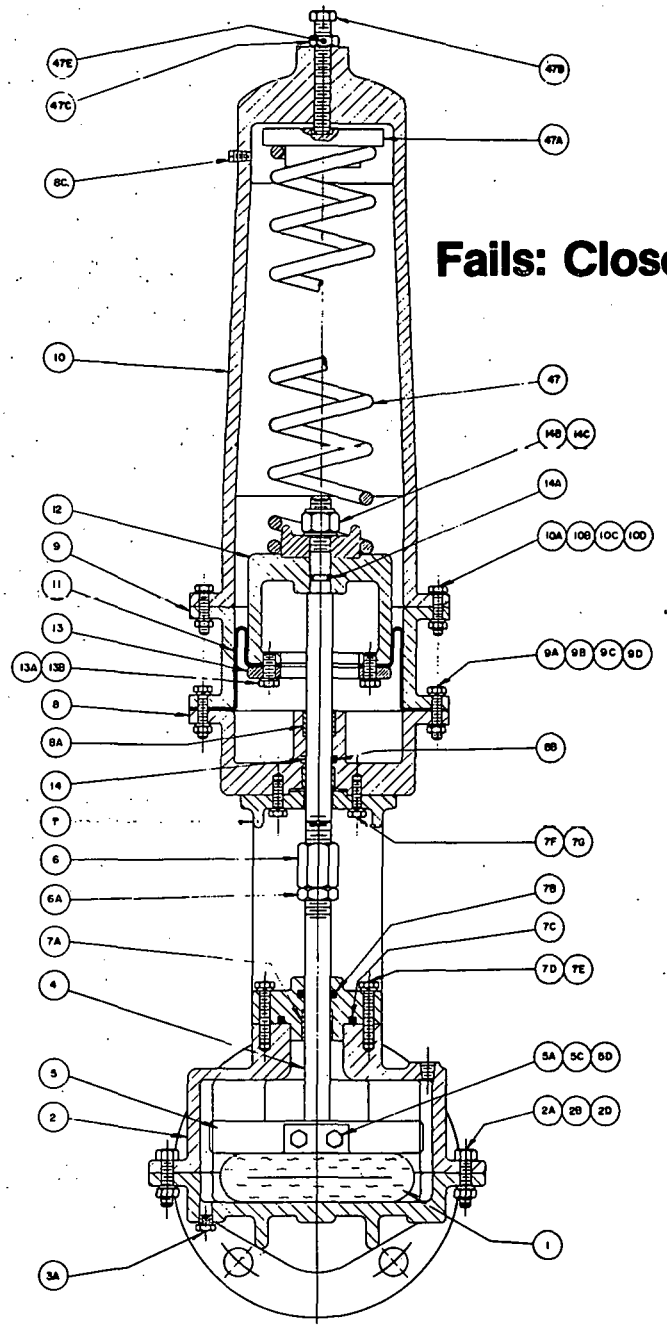
NOTE: ALL DIMENSIONS ARE IN INCHES.

VALVE SIZE	1	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18		
C DIMENSION	6	6	8	10	12	16	15	18	24	30	36	42	45	50-1/4		
D DIAMETER	4-1/4	5	6	7	7-1/2	9	10	11	13-1/2	16	19	21	23-1/2	25		
E DIMENSION	2-7/16	2-5/8	3	3-9/16	3-13/16	4-15/16	5-1/2	6	7-13/16	9-1/2	11-5/8	13	14-1/8	16-3/4		
F DIMENSION	5-1/4	6-1/8	7	8-7/8	10-1/4	12-1/8	13-1/4	15-7/8	18-3/4	22	26	29	33-3/4	39-1/2		
G DIMENSION	8-7/8	8-7/8	8-7/8	10-11/16	10-11/16	13-13/16	13-13/16	13-13/16	19-1/2	19-1/2	20	20	20	20		
H DIMENSION(THK)	1-1/16	1-1/8	1-7/16	1-1/2	1-9/16	1-11/16	1-3/4	1-7/8	2-1/8	2-7/16	2-3/4	3	3-3/4	3-3/4		
K DIMENSION	2-1/4	2-1/4	2-1/4	2-3/8	2-3/8	2-5/8	2-5/8	2-5/8	3-1/4	3-1/4	5-1/4	5-1/4	5-1/4	5-1/4		
L DIMENSION																
M DIAMETER																

RKL CONTROLS

Model LAF-ATOSP-OY
Enclosed, Pre-Pinched

ITEM	DESCRIPTIONS	REQ'D	
1.	BODY	1	
2.	BONNET ASS'Y	1	
2A.	BOLT, BONNETS	*	
2B.	LOCK WASHER, BONNETS	*	
2D.	NUT, BONNETS	*	
8C.	BREATHER PLUG, ACTUATOR	1	
3A.	PLUG, LOWER BONNET	1	
4.	STEM, VALVE	1	
5.	PINCH BAR	1	
5A.	BOLT P.O.F.	2	
5C.	WASHER, P.O.F.	4	
5D.	NUT, P.O.F.	2	
6.	COUPLING	1	
6A.	JAM NUT, COUPLING	1	
7.	YOKE	1	
7A.	BEARING, YOKE	1	
7B.	"O"-RING, YOKE-STEM	1	
7C.	"O"-RING, YOKE-BONNET	1	
7D.	BOLT, YOKE-BONNET	4	
7E.	LOCK WASHER, YOKE-BONNET	4	
7F.	BOLT, YOKE-ACTUATOR	4	
7G.	LOCK WASHER, YOKE-ACTUATOR	4	
8.	CYLINDER BOTTOM, ACTUATOR	1	
8A.	BEARING, CYLINDER BOTTOM	2	
8B.	"O"-RING, CYLINDER BOTTOM	1	
9.	CYLINDER MIDDLE, ACTUATOR	1	
9A.	BOLT, MIDDLE-BOTTOM CYLINDER	*	*
9B.	LOCK WASHER, MIDDLE-BOTTOM CYLINDER	*	*
9C.	WASHER, MIDDLE-BOTTOM CYLINDER	*	*
9D.	NUT, MIDDLE-BOTTOM CYLINDER	*	*
10.	CYLINDER HEAD ACTUATOR	1	
10A.	BOLT, HEAD-MIDDLE CYLINDER	*	*
10B.	LOCK WASHER, HEAD-MIDDLE CYLINDER	*	*
10C.	WASHER, HEAD-MIDDLE CYLINDER	*	*
10D.	NUT, HEAD-MIDDLE CYLINDER	*	*
11.	DIAPHRAGM	1	
12.	PISTON, ACTUATOR	1	
13.	PISTON RING, ACTUATOR	1	
13A.	BOLT, RING-PISTON	*	*
13B.	LOCK WASHER, RING-PISTON	*	*
14.	STEM ACTUATOR	1	
14A.	"O"-RING, PISTON	1	
14B.	WASHER, PISTON-STEM	1	
14C.	LOCK NUT, PISTON-STEM	1	
47.	COMPRESSION RETURN SPRING	1	
47A.	BUTTON, SPRING	1	



Fails: Closed

47B.	JACK BOLT, SPRING	1
47C.	NUT, SPRING	1
47E.	SET SCREW, SPRING	1

CHART NO. 1

ITEM	QUANTITY PINCH VALVE BONNET															
	1	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24
2A 2B 2D	6	8	10	10	10	12	14	14	14	18	18	18	28	32	32	32

CHART NO. 2

ITEM	QUANTITY ACTUATOR							
	14	26	47	60	100	150		
9A0A 9A0B 9A0C 9A0D	10	12	15	15	15	20		
13A 13B	6	6	6	8	12	15		

* SEE "CHART NO.1"

** SEE "CHART NO.2"

INSTALLATION & MAINTENANCE

(AIR-TO-OPEN, SPRING-TO-CLOSE)

The above listed Series of RKL pinch type valves are standard valve mechanisms with an air-to-open, spring-to-close actuator.

These series of valves have been completely assembled and tested and the spring tension adjusting bolt set for approximately 10% above the line pressure specified on your order. The valve is ready for installation as it is received.

These valves may be mounted in any position with flow in either direction.

Follow the installation and maintenance instructions attached for the particular type of open body or closed body construction furnished.

The Series L valves are furnished with an alemite lubricating fitting in the spool piece for lubrication every 10,000 cycles. The Series RAF and RA valves should be lubricated directly on the stem with a heavy grease once every 10,000 cycles.

If you want to increase the tension on the spring for a higher line pressure, thru the rubber body, the spring tension adjusting bolt may be screwed inwards after loosening the spring adjusting bolt lock nut.

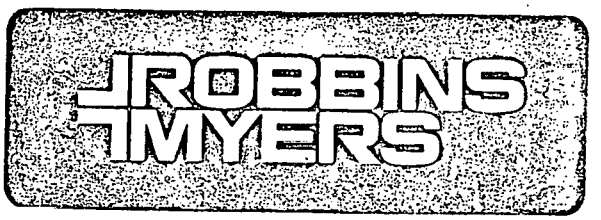
There is a limit to the line pressure this valve will hold with the particular spring furnished you. If you cannot get tight shut off with this spring for an increased line pressure, contact the factory to see if a heavier spring is available for the size actuator you have. Remember, the further in you screw the spring tension bolt, the higher the air pressure required to open the valve.

Be sure the vent hole in the spring cover is clear at all times.

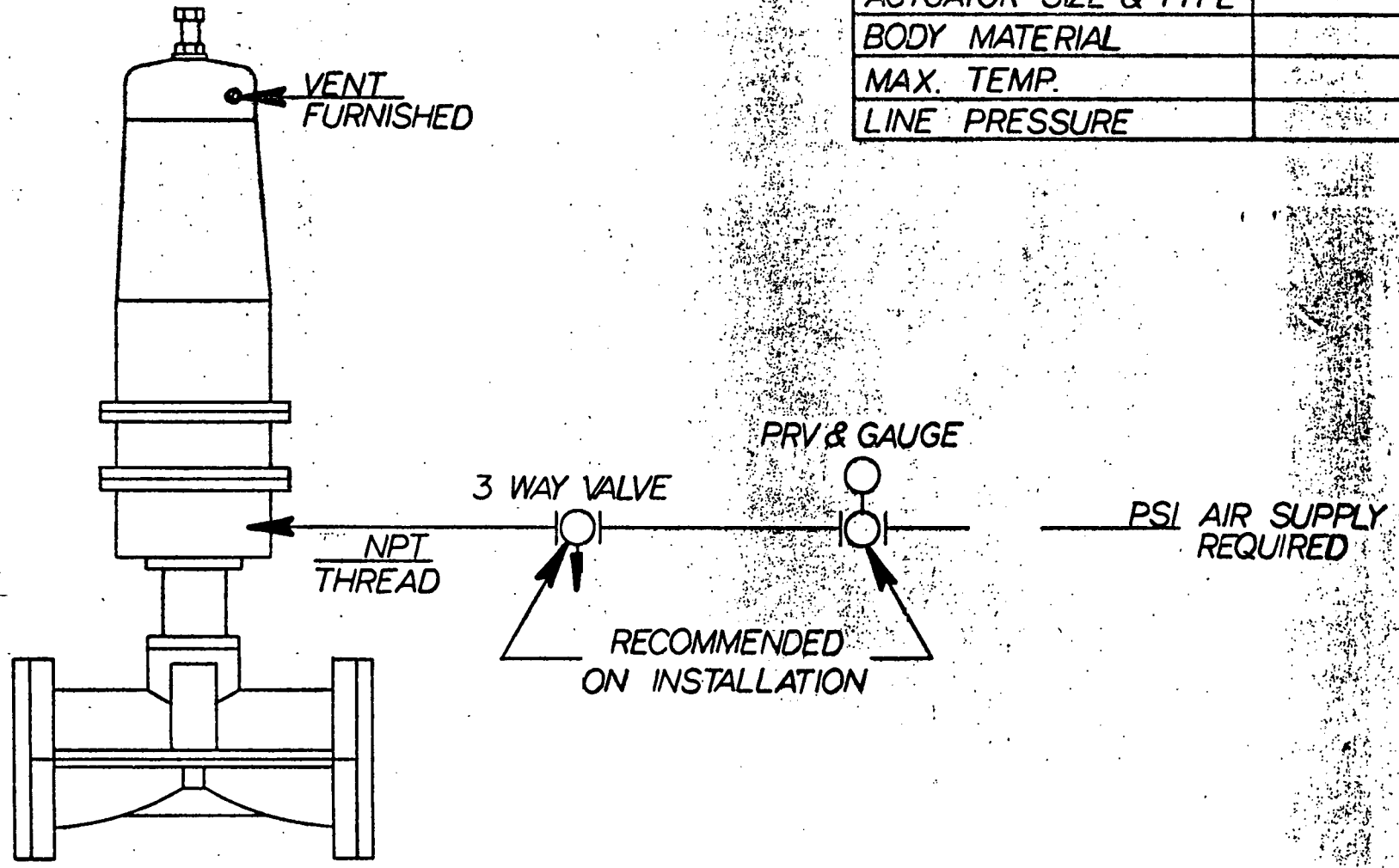
The air hook up for this type air-to-open, spring-to-close valve is shown on the air hook up diagram attached.

IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTIES AND WARRANTIES WILL BE VOID.

RKL CONTROLS
Robbins & Myers, Inc.
P.O. Box 276, Ark Road
Lumberton, NJ 08048
Ph: 609-267-2800 Telex 831-692



VALVE SIZE & TYPE	
ACTUATOR SIZE & TYPE	
BODY MATERIAL	
MAX. TEMP.	
LINE PRESSURE	



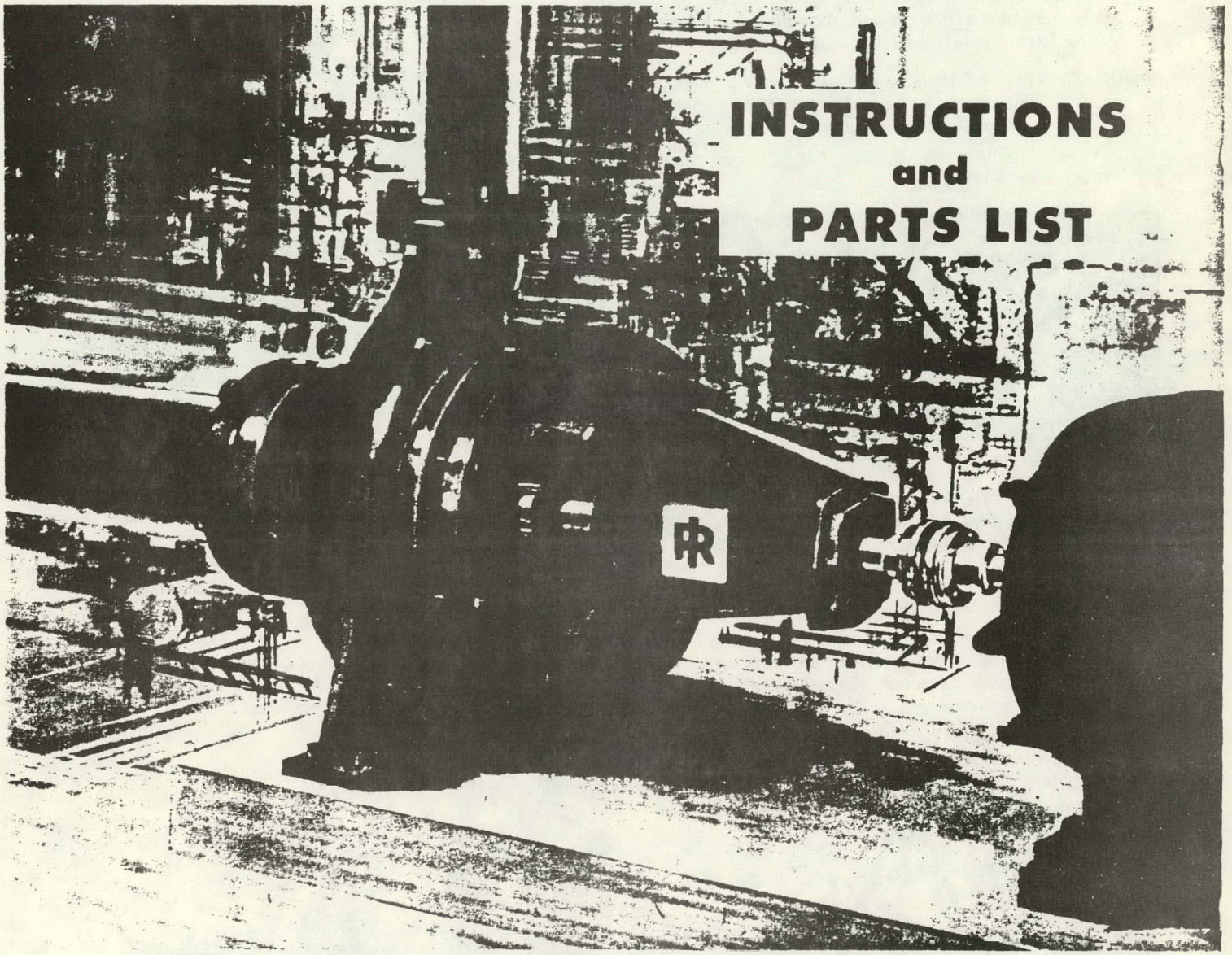
AIR HOOKUP DIAGRAM FOR ATOSP ACTUATED VALVES

RKL CONTROLS, INC.
HAINESPORT INDUSTRIAL PARK
HAINESPORT, N.J.

PUMPS

H/HC

MOTORPUMPS/CRADLE MOUNTED CENTRIFUGAL PUMPS



NOTE: IT IS IMPORTANT THAT THE ENTIRE CONTENTS OF THIS BOOKLET BE STUDIED BEFORE INSTALLATION.

Ingersoll-Rand.
STANDARD PUMP – ALDRICH DIVISION

Form SPAD-27D

MAINTENANCE

WARNING: Before attempting any inspection or repair on the pump the driver controls must be in the "off" position, locked and tagged to prevent injury to personnel performing service on the pump.

DISASSEMBLY

The back withdrawal feature of the pump enables the complete unit to be dismantled without disturbing the pump casing and piping (also the driver, if a spacer coupling is used on the cradle mounted version).

1. Shut off all valves controlling liquid flow to and from the pump and disconnect electrical connections. Drain casing. Drain cradle (if oil lubricated).

WARNING: Before attempting to dissassemble pump, pump must be isolated from system, drained of liquid and cooled, if pump is handling hot liquid.

2. Disconnect seal flushing lines.

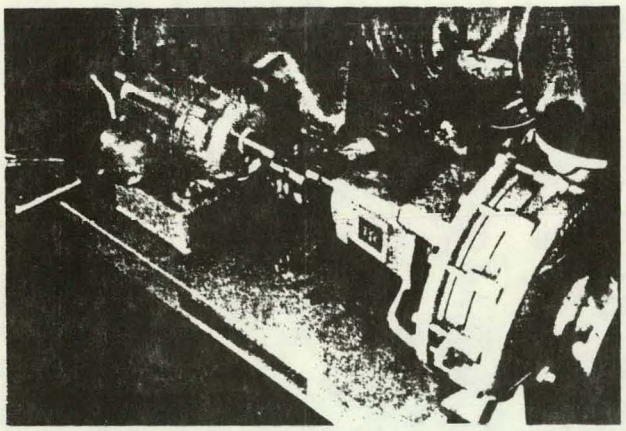


Figure 3

3. Remove spacer coupling. (Fig. 3)
4. Remove casing bolts and bearing housing support when furnished. The complete unit can now be withdrawn from the casing. (Fig. 4) (Including motor on H-motor pumps.)

NOTE:—On larger motor pumps some customers prefer to disconnect piping and remove casing, leaving motor undisturbed.

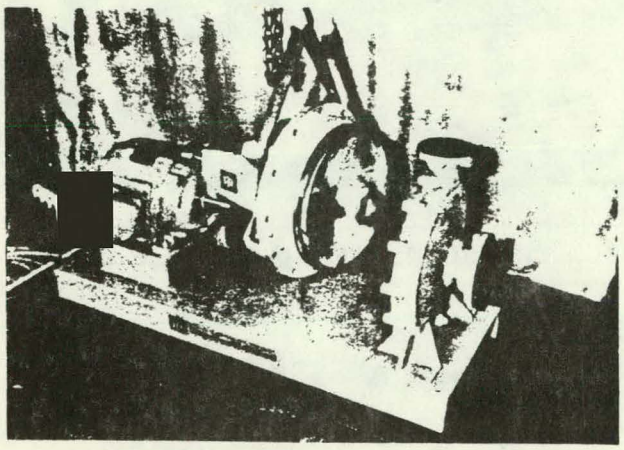


Figure 4

5. With the use of a gear puller withdraw the impeller after removing the retaining bolt (right hand thread) and washer. Be sure pullers are set against impeller vanes.
6. Remove gland nuts and withdraw gland on to shaft. If the unit is soft packed, remove the packing and lantern ring (See section on Packing Replacement).
7. Extract two bolts holding cradle or support head on motor pumps to casing cover. Withdraw casing cover. (Fig. 5)

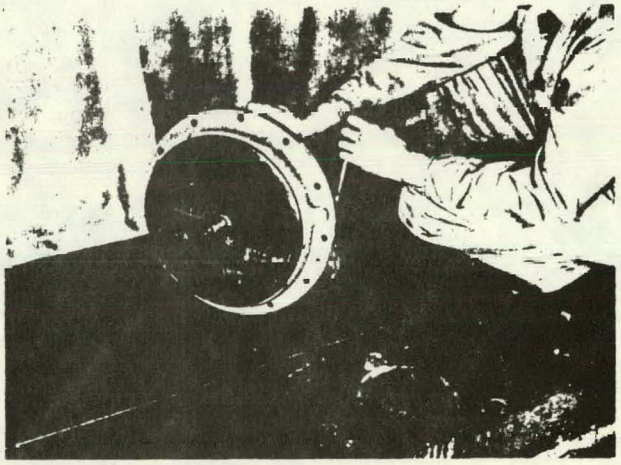


Figure 5

8. Remove shaft sleeve (and mechanical seal if applicable).
9. **Cooled Cover Only**
   For pumps with cooled stuffing box covers, remove special gland studs. This is best accomplished by putting two nuts on the special stud and unscrewing the first against the second. Remove the stat-o-seals and withdraw the cooled cover.

   CAUTION: On pumps for hot service furnished with a cooled stuffing box cover; if for any reason no cooling liquid is provided to the jacket, be sure to vent the jacket to prevent build-up of pressure.

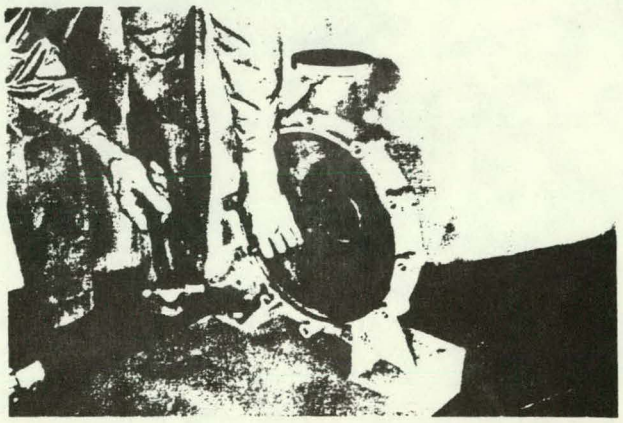


Figure 6

10. To remove wearing rings for replacement, they must be split by using a cold chisel. (Fig. 6)

11. On cradle mounted units the shaft and bearings are removed by removing the bearing end covers and tapping shaft through.

CLEANING AND INSPECTION

WARNING: Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

Discard gaskets and packing as new parts must be used during assembly. All parts must be clean before assembly. This is particularly important at threads, gasket surfaces and radial fit contact areas.

NOTE: Ingersoll-Rand assumes no responsibility or liability for damages caused by the use and failure of the pump which has been fitted with spare or repair parts not of Ingersoll-Rand manufacture. Only genuine parts from Ingersoll-Rand or an authorized Distributor should be used.

Inspect impeller for excessive wear or scoring particularly in wearing areas. Wearing ring clearances should be between .010-.017" diametrically. Check that threads are clean. Ensure that the keyway is not damaged. Check shaft for straightness and corrosion. Check that impeller and coupling fit is between .000 and .002" loose. Check shaft sleeve for straigtness and wear, particularly on soft packed units. Excessive wear or grooves will lead to unacceptable leakage.

Examine keyways and keys. Keys should be snug fitting, but not tight. Examine stuffing box wearing rings and ensure that no wear or scoring has taken place. Check circumferential mating areas for burrs etc. Remove old gasket material and clean up face. Examine the internal bore of the stuffing box to ensure cleanliness and that there is no build up of deposits. Check all threads and tapped holes for burrs.

Inspect surface of gland that contacts packing to be sure that it is clean and smooth. On mechanical seal glands, remove old gasket material and check inside diameter of glands. Inspect coupling keyways. Inspect casing wearing rings for wear and scoring and replace if necessary. Check casing mating surfaces for burrs and remove any old gasket material. Check casing for corrosion and thoroughly clean.

On cradle pumps check that shaft end play is between .002 and .016". On motor pump versions, check the motor shaft extention against the following table. Should any of the limits be exceeded check with the motor manufacturer for recommended repair or replacement parts.

FRAMES	RABBET ECCENTRICITY	FACE RUN OUT	SHAFT RUN OUT
143 – 256	.004 TIR	.004 TIR	.002 TIR
284 – 365	.006 TIR	.006 TIR	.003 TIR

RE-ASSEMBLY PROCEDURE

NOTE:—For H motor pumps steps 1, 2 and 3 do not apply and the support head should be bolted to the motor prior to step 4.

1. Slide bearing on to shaft as far as possible by hand. Light oil lubrication of the shaft will help. Tap or press bearings up to locate shoulders. Do not use excessive force if bearings are being tapped onto shaft as this may damage the races and reduce bearing life.

   Heat must not be used particularly on grease packed bearings as the lubrication properties of the grease may be impaired.
2. Place shaft and bearing assembly into cradle. Lightly lubricate bearing outside diameter and tap into place if necessary.
3. Bolt bearing end covers to cradle. For oil lubricated units, place lip seals in position in end covers.
4. Position seal stationary sealface and gasket in gland (mechanical seal only) and place gland on shaft. Position seal on sleeve and fit out to shaft.
5. If applicable locate wearing ring into casing cover. This is a light interference fit, and should be pressed in. Cooling the wearing ring in a freezer will assist the operation.
6. **Cooled Cover Only**
   For pumps with cooled stuffing box covers position gasket and o-ring after making sure seating surfaces and o-ring grove are clean. Refer to page 12 or 14 for proper positioning of gaskets.

   Assemble cooling cover to casing cover and place stat-o-seals on special gland studs. Tighten the special gland studs using double nut method described in Disassembly, paragraph 9. The cooling cover is now clamped into position.
7. Position casing cover on shaft and bolt to cradle (support head on motor pumps).
8. Locate impeller drive key and then bolt impeller into position. Ensure that the drive key is located correctly into the shaft sleeve.
9. Replace casing ring if necessary. Replace gasket, bolt complete assembly to the pump case. Refer to table 2-page 6 for casing bolt torque valves.
10. Bolt gland into position.
11. Assemble bearing housing support (when furnished) with bearing housing and bed.
12. Before starting unit be certain that the impeller rotates freely.

REPLACEMENT OF MECHANICAL SEAL

Mechanical seals should be checked, particularly during the first hours of operation. Minor leakage through the seal usually stops after a short time, however if it continues, stop the pump and examine the seal. Excessive leakage past a mechanical seal usually indicates worn or broken parts, which require replacement.

To replace a mechanical seal the pump must be dismantled (See Disassembly). The stationary part of seal must be removed from the gland and replaced by a new part.

Remove the gasket from the seal cover, thoroughly clean gland and replace gaskets.

Setting of the replacement seal should be carried out in accordance with the seal drawing that is provided with the

unit. With John Crane Type 1 the setting is automatic since the seal is located against a shoulder on the sleeve.

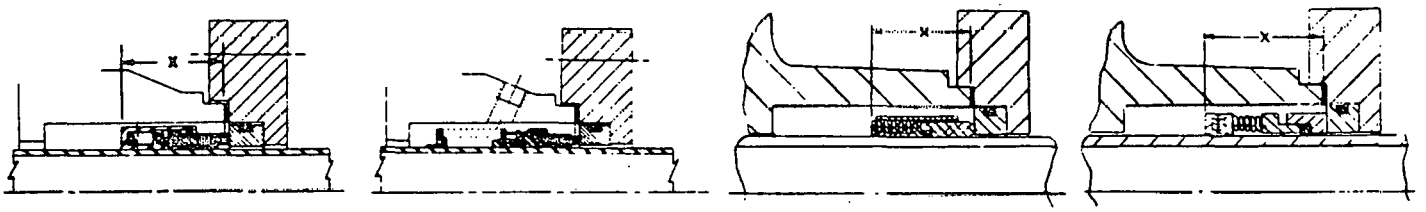
REPLACING SOFT PACKING

When packing becomes worn to the extent that leakage cannot be controlled within desirable limits, it is advisable to repack the stuffing box.

1. Remove bolts securing gland, and withdraw gland.
2. With the aid of a hook, pull the packing and seal cage ring from the stuffing box.
3. Thoroughly clean stuffing box and inspect sleeve before repacking. Leakage may be due to a worn sleeve requiring replacement.
4. Install two (2) rings of packing, ensuring that joints are staggered.
5. Insert Seal Cage. (If used)
6. Insert three rings (four if seal cage is not used) of packing.
7. Insert gland nuts and draw down finger tight. Ensure that the nuts have been tightened evenly, then tighten nuts an extra 1/4 turn to initially set the packing.

SEAL TYPES AND SETTINGS

SETTING DIMENSIONS APPLY TO O-RING SEATS OR SEATS WITH TEFLON WEDGES IN ALL CASES.



CRANE TYPE 8

Shaft Dia.	X	W/Flush Gland X
1-1/8	1	7/8
1-1/2	1-1/16	15/16
1-7/8	1-5/16	1-3/16

CRANE TYPE 1

No Manual Setting Required. Seals are automatically set by shaft sleeve design.

BORG WARNER TYPE Q

Shaft Dia.	X
1-1/8	1-3/8
1-1/2	1-3/8
1-7/8	1-11/16

DURAMETALLIC TYPE RO

Shaft Dia.	X
1-1/8	1-15/16
1-1/2	1-15/16
1-7/8	2-1/16

ORDERING INSTRUCTIONS

BY GIVING COMPLETE INFORMATION, YOU WILL ENABLE US TO FILL YOUR ORDER CORRECTLY AND AVOID UNNECESSARY DELAYS.

HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, please specify:

1. The SIZE & TYPE, and SERIAL NUMBER as stamped on the PUMP name plate. (The Size is the numerical prefix to the Type).
2. The FORM NUMBER of this booklet. (FORM SPAD-27)
3. The QUANTITY.
4. The PART NUMBER and DESCRIPTION exactly as listed.

EXAMPLE

2-1/2 x 1-1/2 x 12 HC SERIAL No. 0272-4502
FORM SPAD 27C
1 – CASING – 2469
1 – IMPELLER – 1129

HOW TO ORDER MOTOR PARTS

Complete motor & motor parts shown in the parts list must be procured from I-R.

HOW TO SELECT *Recommended Spares*

Each Parts List shows the parts which are included in each of the following three classes of recommended spares:

CLASS 1–MINIMUM–Suggested for Domestic Service when pump is handling clean, noncorrosive liquids and where interruptions in service are not important.

CLASS 2–AVERAGE–Suggested for Domestic Service when pump is handling abrasive or corrosive liquids and where some interruptions in continuity of service are not objectionable.

CLASS 3–MAXIMUM–Suggested for Export Marine or Domestic Service where interruptions in service are objectionable.

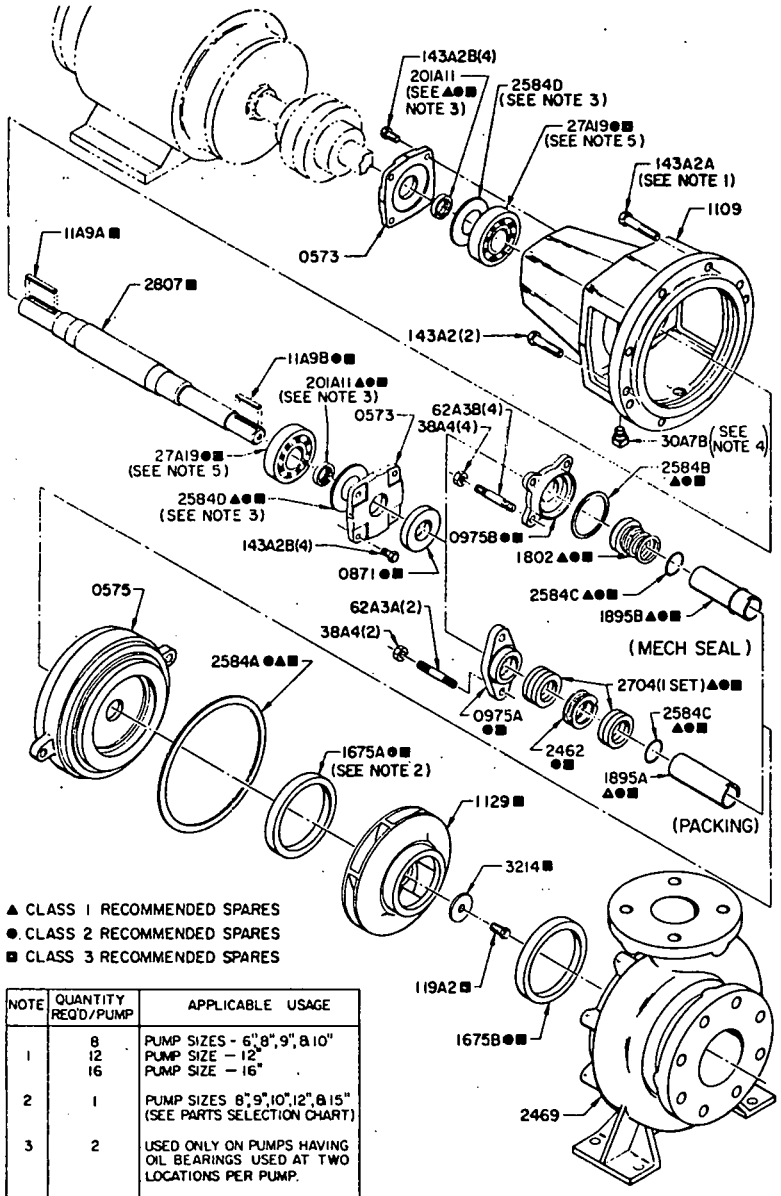
Our Sales Representative in your area will gladly review the class of spares best suited to meet your requirements.

When ordering recommended spares, please follow the procedure as outlined for replacement parts.

–IMPORTANT–

When ordering motor parts, always give the Motor Serial Number and the Model Number as read from the motor name plate. Also furnish the Pump Serial Number.

REFER ALL COMMUNICATIONS TO THE NEAREST ADDRESS LISTED ON THE BACK COVER OR TO THE NEAREST INGERSOLL-RAND DISTRIBUTOR

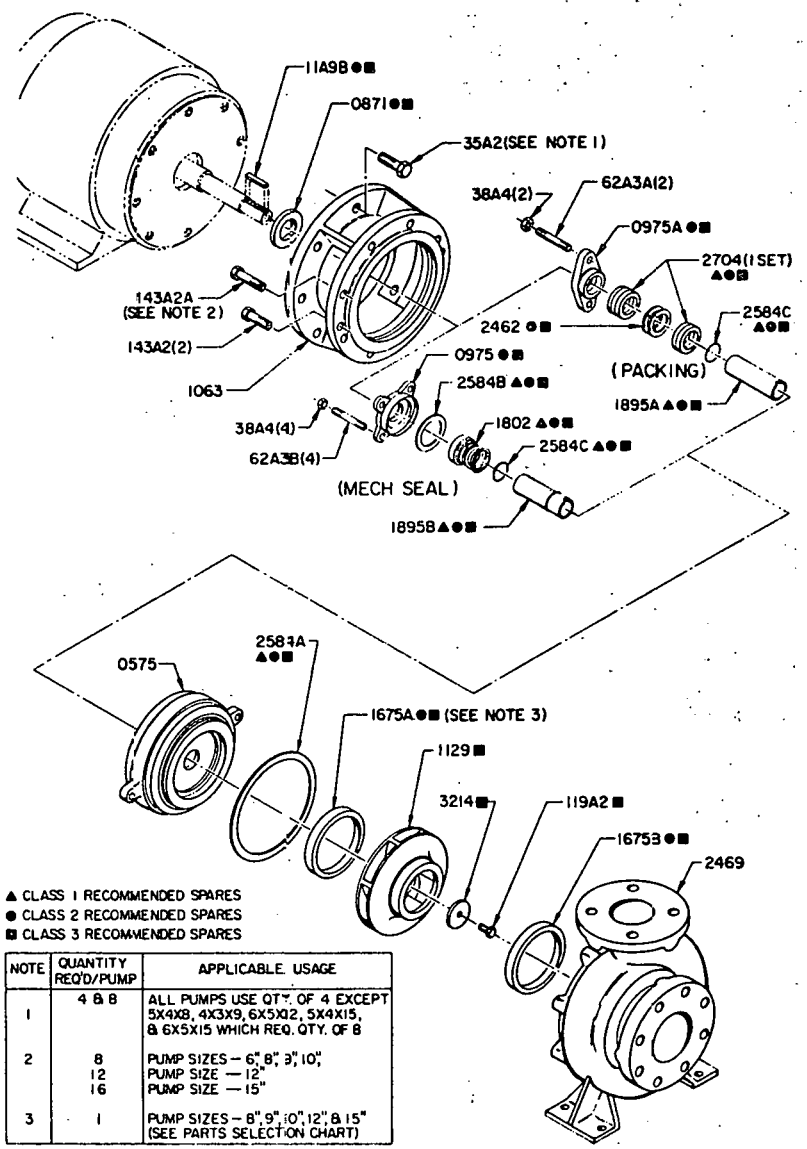


▲ CLASS 1 RECOMMENDED SPARES
● CLASS 2 RECOMMENDED SPARES
■ CLASS 3 RECOMMENDED SPARES

NOTE	QUANTITY REQ'D/PUMP	APPLICABLE USAGE
1	8 12 16	PUMP SIZES - 6", 8", 9", & 10" PUMP SIZE — 12" PUMP SIZE — 16"
2	1	PUMP SIZES 8", 9", 10", 12", & 15" (SEE PARTS SELECTION CHART)
3	2	USED ONLY ON PUMPS HAVING OIL BEARINGS USED AT TWO LOCATIONS PER PUMP.
4	1	USED ONLY ON PUMPS HAVING OIL BEARINGS.
5	2	PUMP SIZE 15" USE 26A19

TYPE HC

MECH DRFTG CTR CLARKS SUMMIT CSA-20



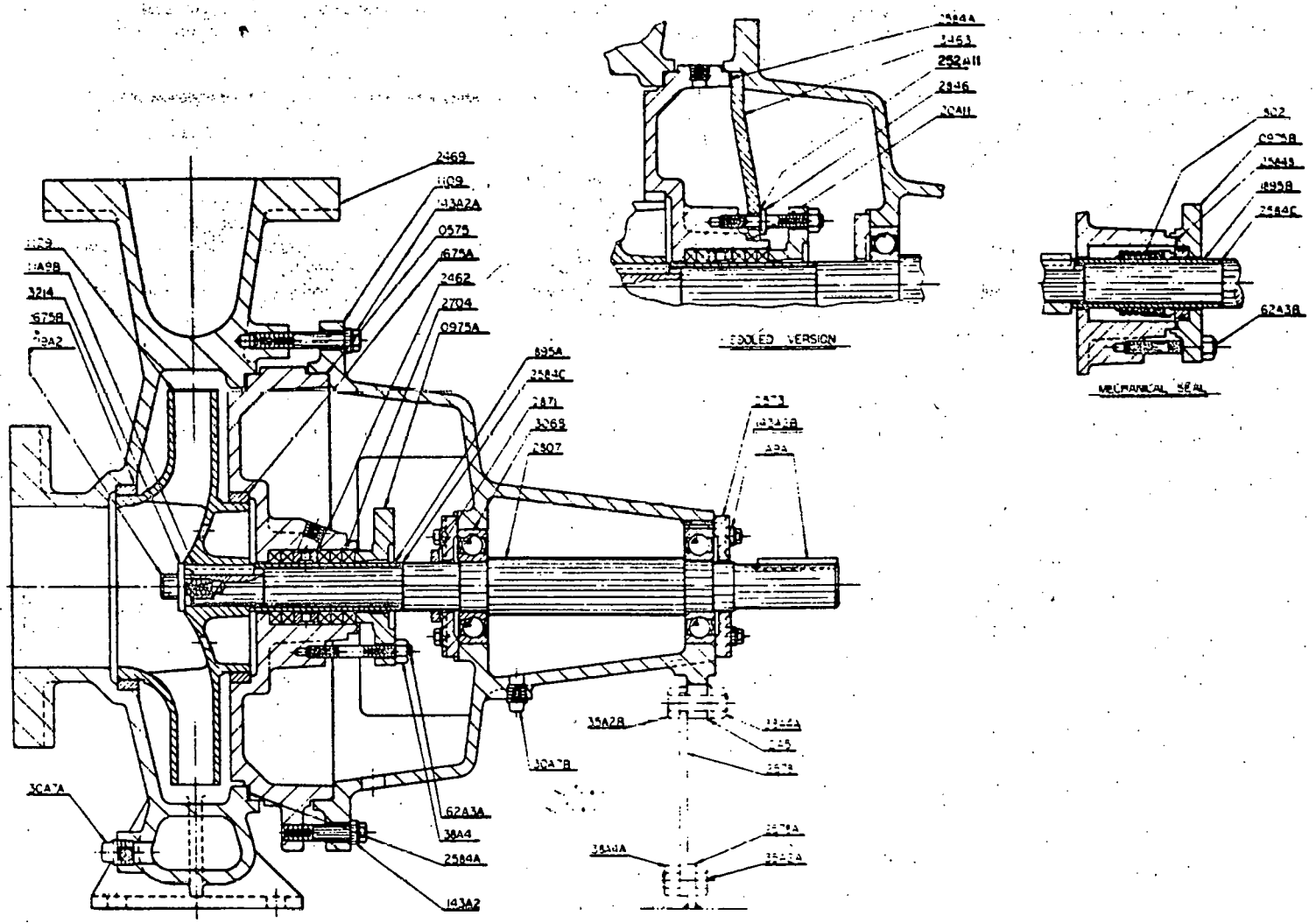
▲ CLASS 1 RECOMMENDED SPARES
● CLASS 2 RECOMMENDED SPARES
■ CLASS 3 RECOMMENDED SPARES

NOTE	QUANTITY REQ'D/PUMP	APPLICABLE USAGE
1	4 & 8	ALL PUMPS USE QTY. OF 4 EXCEPT 5X4X8, 4X3X9, 6X5X12, 5X4X15, & 6X5X15 WHICH REQ. QTY. OF 8
2	8 12 16	PUMP SIZES — 6", 8", 9", 10", PUMP SIZE — 12" PUMP SIZE — 15"
3	1	PUMP SIZES — 8", 9", 10", 12", & 15" (SEE PARTS SELECTION CHART)

TYPE H

MECH DRFTG CTR CLARKS SUMMIT CSA-29

HC CRADLE MOUNTED PUMP
CROSS SECTIONS AND PARTS LIST



Part	Name of Part	Part	Name of Part
0573	End Cover	2846	Stud (Special)
0575	Stuffing Box Cover	3214	Washer
0871	Flinger	3463	Cooling Cover
0975A	Gland (Packed Box)	11A9A	Key (Driver)
0975B	Gland (Mech Seal)	11A9B	Key (Impeller)
1109	Bearing Housing	12A5*	Washer
1129	Impeller	20A11	"O" Ring
1675A	Ring (Stuffing Box Cover)	27A19	Bearings
1675B	Ring (Casing)	30A7A	Pipe Plug
1802	Mechanical Seal (Complete)	30A7B	Pipe Plug
1895A	Sleeve (Packed Box)	35A2A*	Capscrew
1895B	Sleeve (Mech Seal)	35A2B*	Capscrew
2462	Seal Cage	38A4	Nut
2469	Casing	38A4A	Nut
2578*	Bearing Housing Foot	62A3A	Stud (Stuffing Box)
2578A*	Bearing Housing Foot)	62A3B	Stud (Mech Seal)
2584A	Gasket (Casing)	119A2	Capscrew (Impeller)
2584B	Gasket (Seal	143A2	Capscrew
2584C	Gasket (Sleeve)	143A2A	Capscrew
2704	Packing	143A2B	Capscrew
2807	Shaft	252A11	Stat-O-Seal

*Optional not shown.

Auxillary Electric Boiler

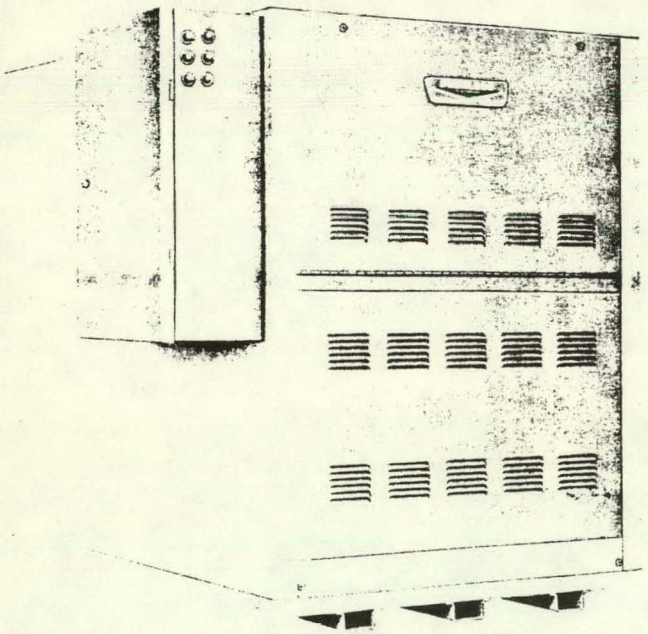
(Hot Water Heater)

PEERLESS
OF BOYERTOWN, PENNSYLVANIA
SINCE 1908

CAST IRON

SERIES peb

Hydronic Electric BOILERS



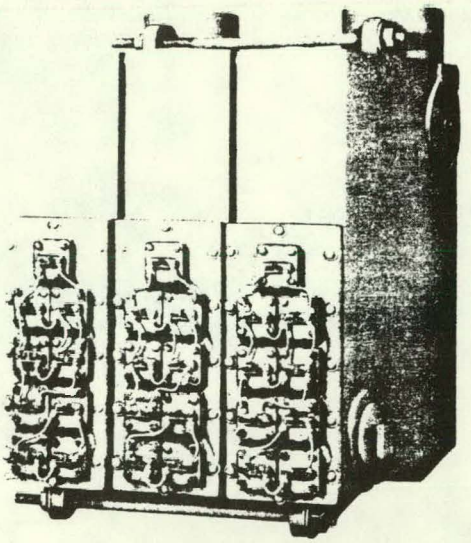
Series PEB-3-45
Rated: 461,000 BTU/Hr. Output

a new design...

FOR
INDUSTRIAL
COMMERCIAL
RESIDENTIAL
Hydronic Heating

STEAM & WATER

Cast Iron Block Assembly with electric heating elements



12 SIZES

RATED: 102,500 to 1,536,800 BTU/hr. Output

Factory assembled, wired and packaged; ready for installation.

Heating At Its Best

The Series "PEB" Cast Iron Electric Boiler incorporates many outstanding engineering and design features in keeping with modern day industrial, commercial and residential plans, when central hydronic heating is desired.

The right is reserved by the manufacturer to make changes at any time without notice.

THE PEERLESS HEATER COMPANY
DIV. OF PEERLESS INDUSTRIES, INC.

BOYERTOWN, PENNSYLVANIA 19512

PEERLESS HEAT
SINCE 1908

ELECTRIC BOILER DATA

Boiler Model No.: PEB-8-45W

Description: 480/60/3 - Proportional Temperature Control (8 Stages) with Immersion Sensor - 30 P.S.I.G. W.W.P.

Boiler Size - KW: 360

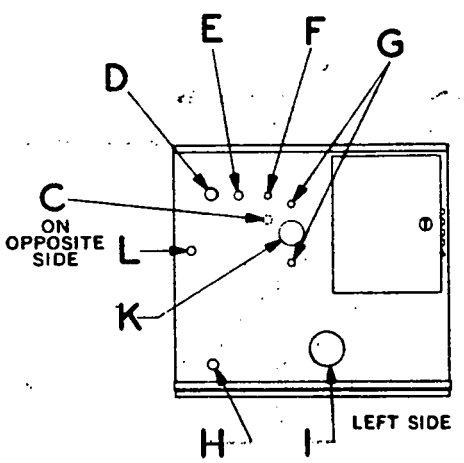
Gross Output - MBH: 1229.4

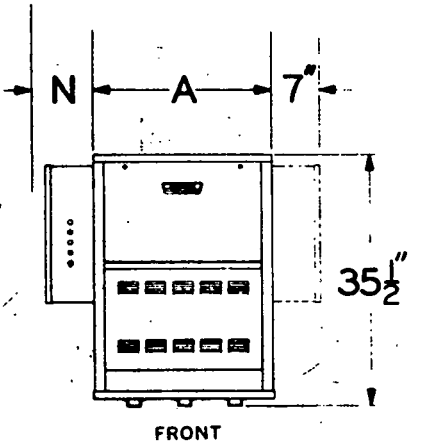
Net Water - MBH: 1069.6

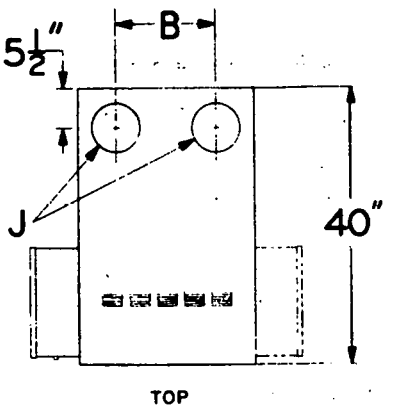
Net Water - Sq.Ft.: 7130

Shipping Weight - Lbs.: 3277

PART	SUPPLIER	PART NUMBER	QUANTITY
Control Transformer	Acme Electric	TA-81213-250VA	1
Theraltimeter	Ametek	84877-3 1/2" Sq.	1
Time Delay Relay	Amperite	115N015	7
Octal Base	Bell Industrial	8QR	7
Mounting Track	Bell Industrial	TK2-12-14"	1
Line Fuse	Buss	JKS-15AMP-600 Volt	2
Heating Element	J.V. Calhoun	TG-2507-16"-5KW-480V.	72
Element Gasket	J.V. Calhoun	2-16717	72
Class J Fuse	Chase Shawnut	A4J30-30AMP (AMP-Trap)	24
Class J Fuse	Chase Shawmut	A4J60-60AMP (AMP-Trap)	24
Indicator Light	Dialight Corp.	135-5763-1431-311 Red	8
Indicator Light	Dialight Corp.	135-5763-1433-311 Amber	1
Neon Glow Lamp	Dialight Corp.	B2A(NE-51H)T-3-1/4"	9
High Limit Control	Honeywell	L4006A1058	1
Contactor	I.T.E. Rowan	2200-EB-430AA-76	8
Contactor	I.T.E. Rowan	2200-EB-430AA-77	1
Contactor	I.T.E. Rowan	2200-EB-430AA-1-77	7
Low Water Cut-Off	McDonnell-Miller	764	1
Immersion Sensor	Penn Controls	A91AAA-11	1
Actrol Staging Control	Penn Controls	R20AB-3	1
Signal Center	Penn Controls	R21AD-1	1
120-24V Transformer	Penn Controls	Y64AL-2-100VA	1
Pressure Relief Valve	Watts	740-1"-30#-1300 MBH	1







NOTE: In addition to the left Terminal Box, a Right Terminal Box is furnished on Models PEB-4 through PEB-6, 208/240 volts; Models PEB-8 through PEB-10, 480 volts.

Series PEB—*RATINGS & DIMENSIONS*

Boiler Model No.	Boiler Size KW	Gross Output MBH	Net Rating*				No. of 5 KW Heater Elements	*** Rated Voltage 3 Phase	*** Rated Amps 3 Phase	Dimensions			
			Water MBH	Water** Sq. Ft.	Steam MBH	Steam Sq. Ft.				"A"	"B"	"N" With 67-PE or 764 LWCO	"N" With 47-2 Feeder
PEB-1-30	30	102.5	89.6	600	77.3	320	6	208/240/480	83/72/36	11"	—	7"	9"
PEB-1-45	45	153.7	133.9	895	115.5	480	9	208/240/480	125/108/54	11"	—	7"	9"
PEB-2-30	60	204.9	178.3	1190	153.8	640	12	208/240/480	167/144/72	18⅜"	7⅜"	7"	9"
PEB-2-45	90	307.4	267.0	1780	230.3	960	18	208/240/480	250/216/108	18⅜"	7⅜"	7"	9"
PEB-3-45	135	461.0	401.7	2680	346.6	1445	27	208/240/480	375/325/163	25¾"	14¾"	7"	9"
PEB-4-45	180	614.7	533.9	3560	460.6	1920	36	208/240/480	500/433/217	33⅛"	22⅛"	7"	9"
PEB-5-45	225	768.4	667.8	4450	576.1	2400	45	208/240/480	625/542/271	40½"	29½"	7"	9"
PEB-6-45	270	922.1	801.7	5345	691.7	2880	54	208/240/480	750/650/325	47⅞"	36⅞"	7"	9"
PEB-7-45	315	1075.7	935.7	6240	807.2	3365	63	480	380	55¼"	44¼"	7"	9"
PEB-8-45	360	1229.4	1069.6	7130	922.7	3845	72	480	434	62⅝"	51⅝"	7"	9"
PEB-9-45	405	1383.1	1203.5	8025	1047.7	4365	81	480	488	70"	59"	7"	9"
PEB-10-45	450	1536.8	1335.7	8905	1174.3	4895	90	480	542	77⅜"	66⅛"	7"	9"

*Net ratings are based on I = B = R piping and pick-up factors for automatically fired boilers.
**Net rating is based on net rating in BTU per hour at 170° boiler water temperature with heat emission of 150 BTU/sq. ft.
***For single phase; PEB-1-30, 240V and 125 Amps. PEB-1-45, 240V and 188 Amps. PEB-2-30, 240V and 250 Amps.

NOTE: On multiple boiler installations, allow at least 30" between boilers for servicing.

SERIES PEB ELECTRIC BOILER			
TAPPING LOCATION, SIZE & USE			
LOCATION	SIZE NPT	STEAM	WATER
C	¾"	—	Auxiliary Limit Control
*D	1½"	Pop Safety Valve	Relief Valve
E	¾"	—	Limit & Operating Control
F	½"	Steam Gauge	Theraltimeter
G	½"	Low Water Cut-Off	—
*H	1"	Boiler Drain	Boiler Drain
*I	4"	Return	Return
J	5"	Supply	Supply
K	2½"	—	Low Water Cut-Off
*AUXILIARY TAPPING ON OPPOSITE SIDE.			

WORKING PRESSURE:
50 LBS. WATER
15 LBS. STEAM
80 LBS. WATER (Available)

Underwriters' Laboratories, Inc. LISTED

A. S. M. E.

SERIES PEB ELECTRIC BOILERS

STANDARD EQUIPMENT: (WATER)

1. Deluxe type steel insulated jacket
2. Limit & operating control
3. Low water cut-off
4. Pressure relief valve A.S.M.E. 30 lb.
5. Power supply terminal box(es)
6. Control transformer
7. Theraltimeter
8. Drain cock
9. Combination magnetic contactors & fuse blocks
10. Flange type immersion elements sheathed in copper alloy
11. Time delay relays - 15 second
12. Completely wired & assembled

POWER SUPPLY TERMINAL BOX INCLUDES: POWER SUPPLY TERMINAL BLOCK, PILOT LIGHTS INDICATING EACH STAGE, POWER "ON-OFF" SWITCH WITH LIGHT, CONTROL TRANSFORMER, TIME DELAY RELAYS.

STANDARD EQUIPMENT: (STEAM)

Same as water except, pressure limit control, pressure operating control, compound steam pressure gauge in lieu of theraltimeter, A.S.M.E. pop safety valve (side outlet) 15 lb. in lieu of water pressure relief valve, gauge glass set.

OPTIONAL EQUIPMENT:

Sequencing indoor-outdoor control, combination pump and low water cut-off control (steam only), combination low water cut-off feeder.

DISTRIBUTED BY:

G — STARTING THE BOILER

1—PRE-START UP

a. IMPORTANT—On Steam boilers be sure boiler and system has been cleaned properly to insure against surging or boiler priming. The method for cleaning is described in the attached CARE AND OPERATION OF PEERLESS BOILERS. After cleaning, fill boiler to the prescribed water line height of 24" above the floor.

b. On Water boilers, be sure the system has been filled with water and vented free of air.

c. Check all electrical connections as some may have loosened in shipment.

d. Check to see that all fuses are in place.

2—START-UP

a. Set the thermostat or operating control to desired setting.

b. Close the main power switch.

c. Close the "Power" switch in the Terminal Box.

d. Boiler is now in an operating condition.

H — SERVICE AND MAINTENANCE

1—Do not maintain a higher temperature than is necessary to comfortably heat the building.

2—On a water boiler, if it is necessary to add water in excess of ½ lb. gauge pressure per month, check for leaks and correct immediately. If water is required to renew the water line in a steam boiler at least once a month also check for leaks and correct immediately. Excessive introduction of make up water may result in the formation of lime scale and sludge on the heater elements, which will reduce the life and effectiveness of the heating elements.

3—If it is necessary to clean or replace the heating elements, drain the boiler and system. Disconnect the wiring to each element separately and remove the element from the boiler. Clean or replace element, reinstall it in the boiler and rewire it before removing the next element. This will avoid getting the wiring mixed. To clean the elements, use a brush and detergent solution to remove all sludge and lime scale deposits.

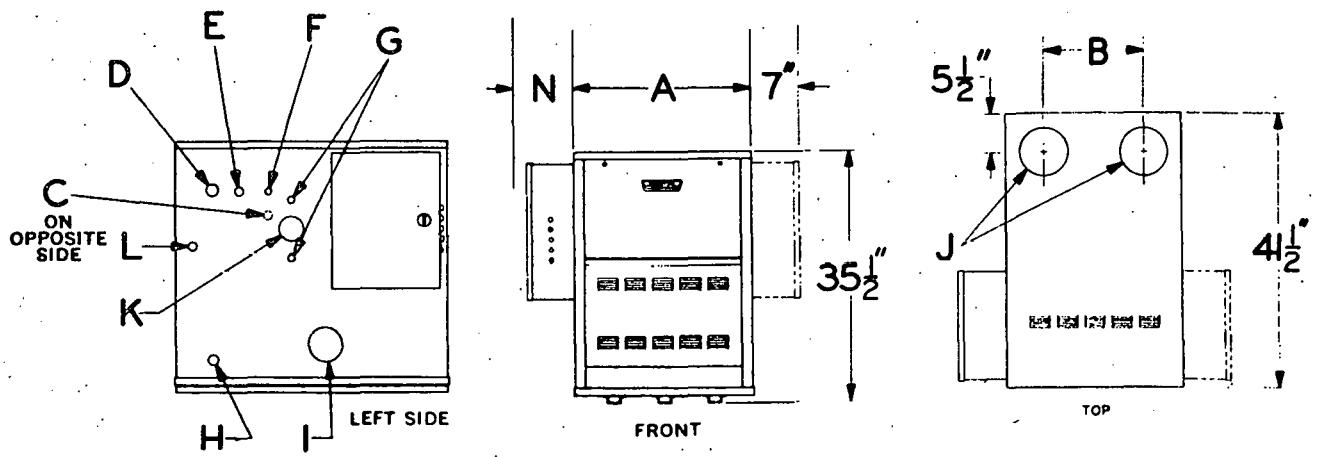
When reinstalling the elements be sure to use new gaskets behind the element flanges.

4—From time to time the contacts on the contactors may become dirty or burned and fail to transfer power to the heating elements. Cleaning of the contacts can be accomplished by drawing a piece of hard card stock (file card or calling card) between the contacts or use a contact burnishing tool. If the contacts are burned badly, the contactor should be replaced.

5—There is no positive way of telling whether a heating element has burned out without testing the element continuity. It is therefore suggested that at least twice a heating season the continuity of the elements be checked. A simple continuity meter or indicator is all that is required. If the needle on the meter does not register when the probes touch the two element terminals, the element is then defective.

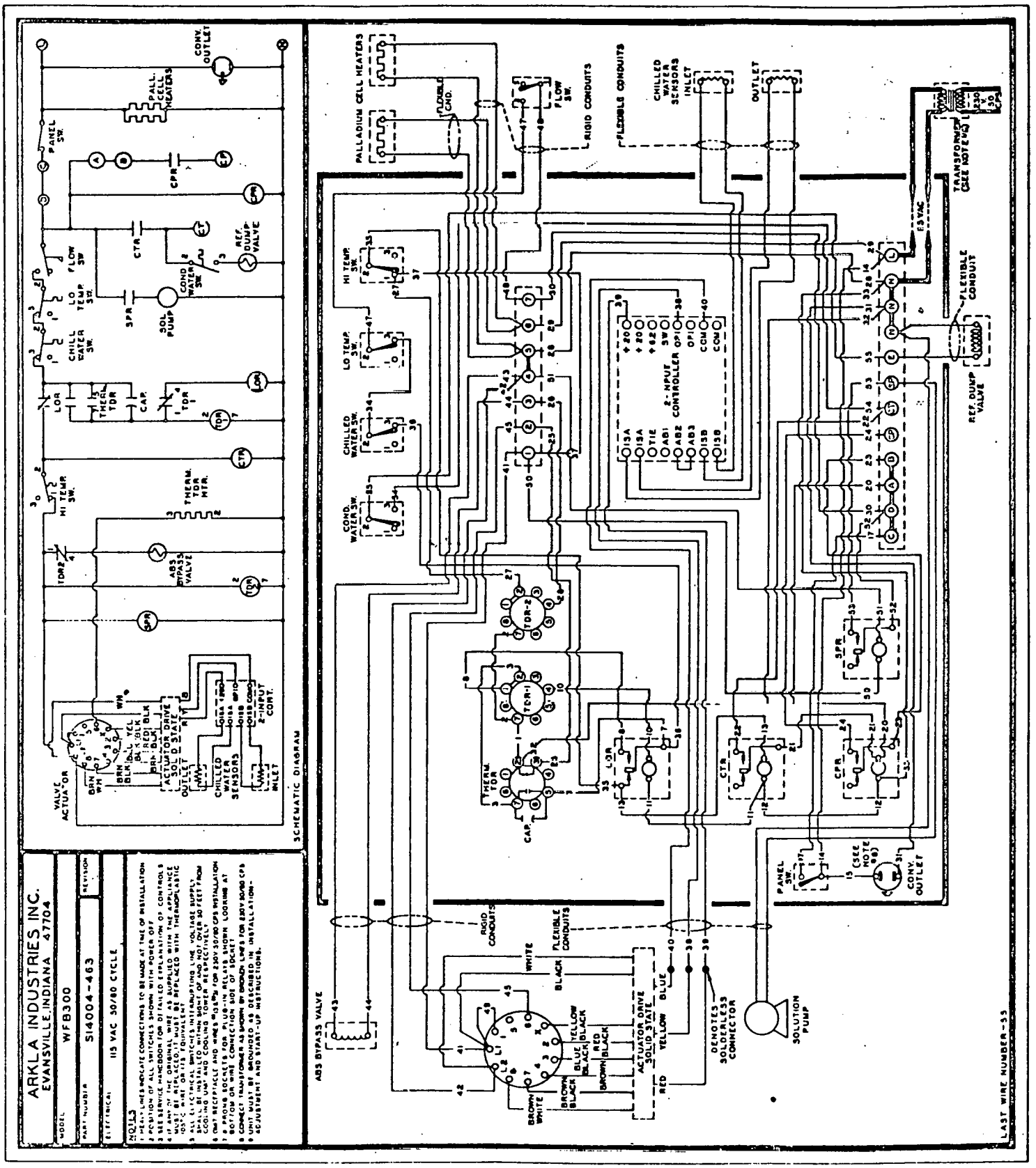
A blown fuse would also indicate an element failure, however, a continuity test would still be required to determine which one actually has failed as the elements are grouped together in a delta connection.

NOTE: When inspecting the heating element and it is noted the sheathing has disintegrated; this is a direct indication the element was not covered by water. The low water cut-off function should then be checked and also check for the possibility of air trapped in the boiler and around the elements.



NOTE: In addition to the left Terminal Box, a Right Terminal Box is furnished on Models PEB-5 and PEB-6, 208/240 volts; Models PEB-8 through PEB-10, 480 volts.

Figure 14


ARKLA INDUSTRIES INC.
EVANSVILLE, INDIANA 47704
MODEL WFB300
PART NUMBER S14004-463
REVISION
ELECTRICAL 115 VAC 50/60 CYCLE
NOTES
SCHEMATIC DIAGRAM
PALLADIUM CELL HEATERS
FLEXIBLE CND.
FLOW SW.
RIGID CONDUITS
FLEXIBLE CONDUITS
CHILLED WATER SENSORS INLET
OUTLET
CONV. OUTLET
PANEL SW.
HI TEMP SW.
LO TEMP SW.
CHILLED WATER SW.
COND. WATER SW.
CHILL WATER SW.
LO TEMP SW.
COND WATER SW.
SOL PUMP
REF. DUMP VALVE
ABS BYPASS VALVE
THERM. TDR HTR.
TDR-1
TDR-2
THERM TDR
CAP.
LOR
CTR
CPR
SPR
ETR
2-INPUT CONTROLLER
ACTUATOR DRIVE SOLID STATE
SOLUTION PUMP
DENOTES SOLDERLESS CONNECTOR
TRANSFORMER (SEE NOTE 6)
115VAC
FLEXIBLE CONDUIT
LAST WIRE NUMBER-33

COOLING TOWER

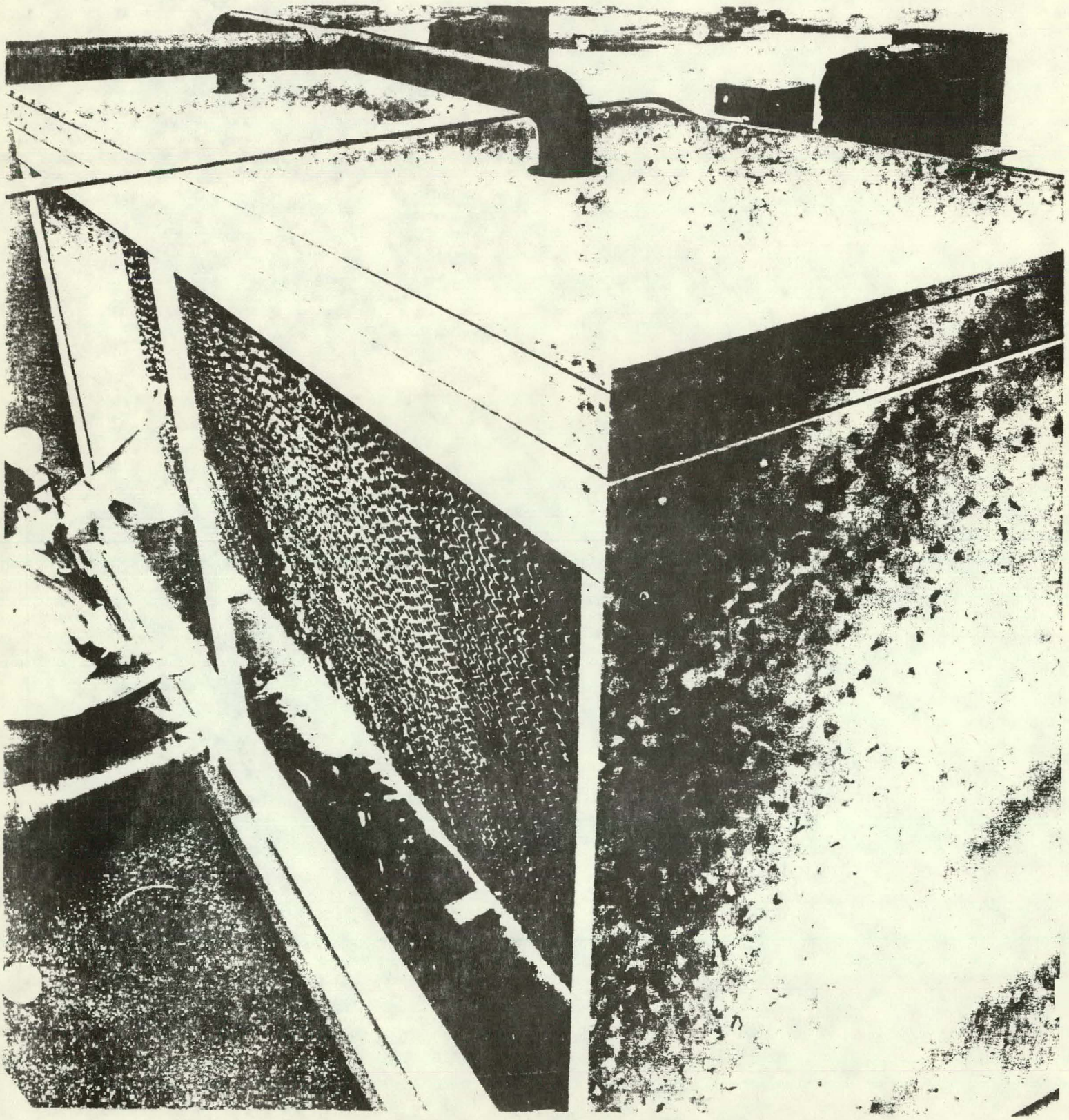
BULLETIN CT-102

Ken Wicks
215-565-0628

HALSTEAD & MITCHELL

COOLING TOWERS

WITH FIREPROOF ASBESTOS FILL



NEW HALSTEAD & MITCHELL COOLING TOWERS PROVIDE UP TO 25% MORE COOLING CAPACITY with no increase in cabinet size.

ASBESTOS WETTED DECK SURFACE

The inorganic and incombustible wetted deck surface is impervious to fungus growth and other decay organisms. In addition to adding more cooling capacity with no increase in size, the lightweight decking also helps our cooling towers outperform other types of decking. You're assured of a cooling tower to meet your exact specifications.

No fill surface used commercially today provides as much water cooling capacity per cubic foot as does H&M's new asbestos wetted deck.

LARGE CAPACITY SUMP

Constructed of heavy gauge steel. Welded throughout to eliminate leaks. Extra large volume sump accommodates water supply.

LOW NOISE LEVEL FANS

The deep pitch, slow-speed fans cut noise level to a minimum. The long-lasting, zinc-plated, chrome-dip finish protects the heavy steel blades against corrosion.

LIFE-LUBRICATED BEARINGS

Fan bearings are factory lubricated and permanently sealed for exceptional moisture resistance. Maintenance is reduced to a minimum. The bearing housing is durable malleable iron.

WEATHER-RESISTANT MOTORS

The motors are suitable for outdoor operation and laboratory-approved for most adverse voltage and loading conditions. Weather shield for pulley and belt permits use even in icing conditions.

WATER LEVEL CONTROL

A brass float valve maintains proper water level in the sump. The float ball is tough, corrosion-resistant plastic.

CABINET CONSTRUCTION AND FINISH

Tower sides are constructed of galvanized steel. The sump is given special protection.

GCKA Models are shipped assembled but feature knock-down design.

OPTIONAL ACCESSORIES

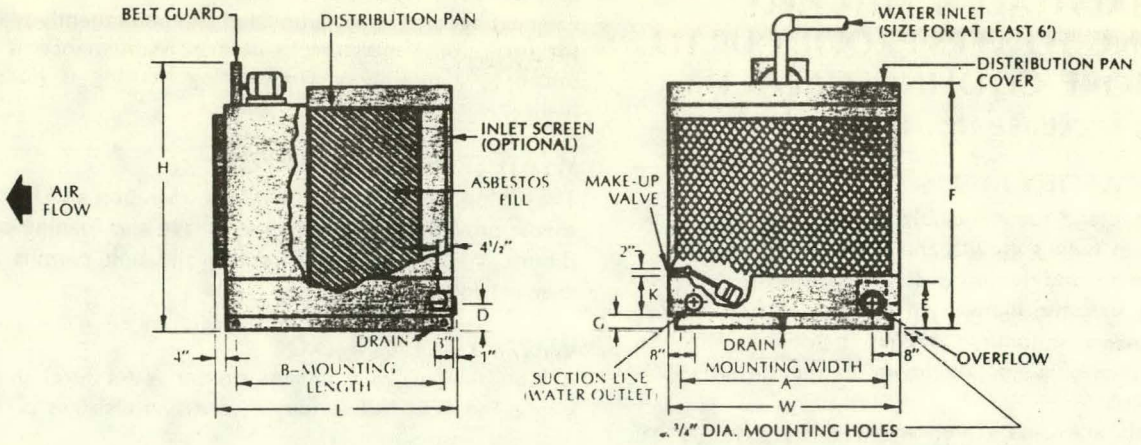
- Motor hood
- Outlet water screen
- Inlet air screen
- Stainless steel fans

TABLE 1 · GCKA COOLING TOWER PERFORMANCE · TONS OF REFRIGERATION*

HOT WATER, °F		**90**	**95**	**87**	**95**	**92**	**96**	**97**	**95**	**97**	**95**	**96**	**96**
COLD WATER, °F		**80**	**85**	**77**	**85**	**82**	**86**	**87**	**85**	**87**	**85**	**86**	**86**
WET BULB, °F		**65**	**70**	**70**	**72**	**72**	**73**	**75**	**75**	**78**	**78**	**79**	**80**
3 GPM/TON COOLING TOWER MODEL NUMBER GCKA	5	7.3	8.3	4.3	7.5	5.9	7.5	7.2	6.5	6.0	5.0	5.0	4.5
	7½	11.0	12.5	6.3	11.0	8.7	11.5	11.0	9.5	9.0	7.5	7.5	7.0
	10	14.8	16.5	8.5	15.0	11.8	15.2	14.5	12.5	12.0	10.0	10.0	9.2
	15	22.3	24.8	12.6	22.5	17.8	22.5	22.0	19.0	18.5	15.0	15.5	14.0
	20	29.9	33.3	17.0	30.2	23.9	30.5	29.5	25.5	24.7	20.0	20.5	18.5
	25	37.7	41.4	21.0	37.5	29.5	38.0	36.5	31.5	30.5	25.0	25.5	23.2
	30	44.3	49.5	25.0	44.5	35.5	45.5	44.0	37.7	36.7	30.0	30.5	27.7
	40	59.0	66.0	33.3	59.5	47.3	61.0	58.7	50.5	49.0	40.0	40.5	37.0
	50	73.9	82.5	41.8	75.0	59.0	76.0	73.5	63.0	61.0	50.0	51.0	46.0
	60	89.0	99.0	50.0	89.0	71.0	91.0	86.5	75.0	72.0	60.0	60.0	54.0
	75	110.0	125.0	63.0	110.0	87.0	115.0	110.0	95.0	90.0	75.0	75.0	70.0
	100	148.0	165.0	83.6	150.0	118.0	152.0	145.0	124.0	122.0	100.0	101.0	90.0
	120	178.0	198.0	100.0	180.0	141.0	182.0	174.0	149.0	146.0	120.0	121.0	108.0
	150	222.0	247.0	125.0	224.0	176.0	228.0	217.0	186.0	182.0	150.0	151.0	134.0
HOT WATER, °F		**82.5**	**85**	**89**	**89.5**	**95**	**93.5**	**95**	**93.5**	**95**	**95**	**95**	**97**
COLD WATER, °F		**75**	**77.5**	**81.5**	**82**	**87.5**	**86**	**87.5**	**86**	**87.5**	**87.5**	**87.5**	**89.5**
WET BULB, °F		**65**	**70**	**70**	**72**	**72**	**75**	**75**	**78**	**78**	**79**	**80**	**80**
4 GPM/TON COOLING TOWER MODEL NUMBER GCKA	5	4.7	4.2	6.3	5.7	8.2	6.3	7.2	5.5	6.2	5.5	5.3	5.2
	7½	7.5	6.5	9.5	8.6	12.2	9.5	10.7	8.0	9.2	8.5	8.0	9.5
	10	9.0	8.5	12.5	11.4	16.3	12.6	14.3	10.5	12.2	11.5	10.5	12.7
	15	14.5	12.7	18.7	17.0	24.4	18.9	21.4	16.0	18.5	17.0	15.7	19.2
	20	19.5	17.0	25.5	23.0	33.2	25.5	29.0	21.5	25.0	23.0	21.2	26.0
	25	24.3	21.0	31.5	28.5	41.1	32.1	36.2	26.5	30.0	28.5	26.5	32.0
	30	29.0	25.5	37.7	34.0	49.2	38.0	43.0	32.0	37.0	34.2	31.5	38.5
	40	39.0	39.0	50.2	45.5	65.7	50.7	57.5	42.5	48.5	45.7	42.2	51.5
	50	48.5	42.5	62.7	57.0	82.5	62.7	72.0	52.2	61.0	57.0	52.7	64.0
	60	58.0	51.0	75.5	68.0	98.0	75.0	86.0	63.0	73.0	68.9	62.0	75.0
	75	75.0	65.0	95.0	86.0	122.0	95.0	107.0	80.0	92.0	85.0	80.0	95.0
	100	97.0	85.0	125.5	114.0	165.0	124.5	144.0	103.0	121.0	112.0	103.0	125.0
	120	116.0	102.0	151.0	136.0	198.0	149.0	173.0	124.0	145.0	134.0	124.0	150.0
	150	145.0	127.0	188.0	170.0	247.0	186.0	216.0	155.0	181.0	168.0	155.0	187.0

*1 Tower ton of refrigeration = 15,000 Btu/hr.

5 TO 75 TONS · GCKA MODELS



100 TO 150 TONS · GCKA MODELS

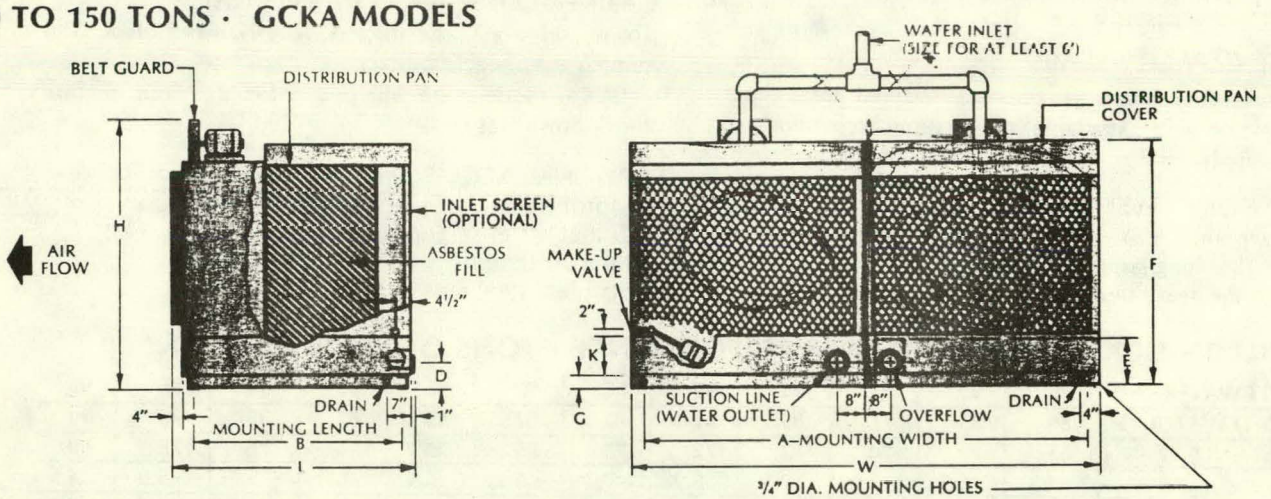


TABLE 2 · SPECIFICATIONS AND DIMENSIONS

MODEL NUMBER	CFM	SUMP CAP. GALS. TO OVERFLOW	MOTOR HP	LBS ESTIMATED WEIGHT		DIMENSIONS (INCHES)										REQUIRED PIPE SIZES INCHES				AIR INLET INCHES		A R OUTLET INSIDE DIA. INCHES
				SHIPPING	WET	OVERALL W	OVERALL L	OVERALL H	A	B	D	E	F	G	K	IN	OUT	OVERFLOW	WATER MAKEUP	WIDTH	HEIGHT	
GCKA-5	1,500	25	1/3	280	488	29	30	51 3/4	25	26	5 1/2	6 1/2	41 3/4	3 1/2	8	1 1/2	1 1/2	1 1/2	1/2	26	27 1/8	24 3/4
GCKA-7 1/2	2,250	35	1/2	300	592	29	42	51 3/4	25	38	5 1/2	6 1/2	41 3/4	3 1/2	8	2	2	1 1/2	1/2	26	27 1/8	24 3/4
GCKA-10	3,000	35	1/2	380	672	29	42	64 1/4	25	38	5 1/2	6 1/2	54 1/4	3 1/2	8	2	2	1 1/2	1/2	26	39 5/8	24 3/4
GCKA-15	4,500	45	1/2	410	785	36	45	64 3/4	32	41	6	6 1/2	54 3/4	4	8	2	2	1 1/2	1/2	33	39 5/8	30 3/4
GCKA-20	6,000	101	3/4	525	1352	36	54	81 1/2	32	50	6 1/2	12	77	4	14	2	3	2	1/2	33	52	30 3/4
GCKA-25	7,500	101	1	545	1372	36	54	81 1/2	32	50	6 1/2	12	77	4	14	3	3	2	1/2	33	52	30 3/4
GCKA-30	9,000	101	1 1/2	560	1387	36	54	81 1/2	32	50	6 1/2	12	77	4	14	3	3	2	1/2	33	52	30 3/4
GCKA-40	12,000	135	2	720	1845	48	54	81 1/2	44	50	6 1/2	12	77	4	14	3	3	2	1/2	45	52	42 3/4
GCKA-50	15,000	168	3	840	2240	60	54	81 1/2	56	50	6 1/2	12	77	4	14	4	4	3	3/4	57	52	48 3/4
GCKA-60	18,000	202	5	1020	1700	72	54	81 1/2	68	50	6 1/2	12	77	4	14	4	4	3	3/4	69	52	48 3/4
GCKA-75	22,500	236	5	1200	3165	84	54	81 1/2	80	42	8 1/8	12	77	4	14	4	6	3	3/4	81	52	48 3/4
GCKA-100	30,000	336	(2) 3	1740	4540	120	54	81 1/2	116	42	8 1/8	12	77	4	14	2@4	6	3	3/4	117	52	2x48 3/4
GCKA-120	36,000	404	(2) 5	2100	5465	144	54	81 1/2	140	42	8 1/8	12	77	4	14	2@4	6	3	3/4	141	52	2x48 3/4
GCKA-150	45,000	472	(2) 5	2460	6390	168	54	81 1/2	164	42	8 1/8	12	77	4	14	2@4	6	3	3/4	165	52	2x48 3/4

Models GCKA 100-150 have twin fans and drives.
Models GCKA 50-150 have double groove pulleys and matched sets of belts.

All dimensions and specifications subject to change without notice. Consult H&M Sales Dept. for verified dimension drawings.

H&M REMOTE TANKS

Halstead & Mitchell offers a complete line of sturdy, large capacity Remote Tanks for installation with H&M cooling towers. All tanks come complete with integral float valve for automatic control of tank water level.

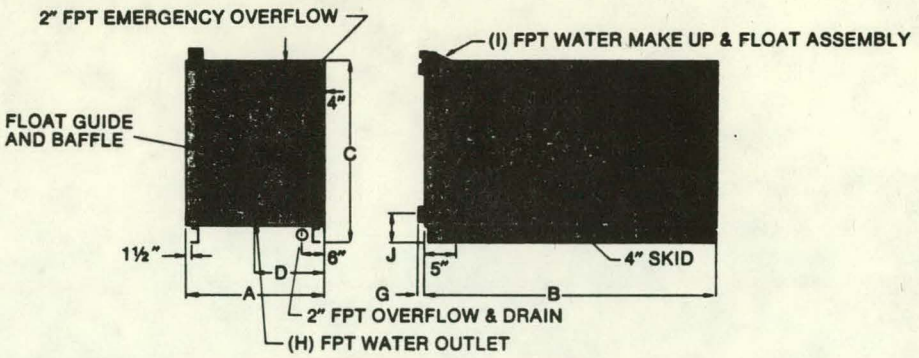


TABLE 3 • REMOTE TANKS

COOLING TOWER MODEL NUMBER	REMOTE TANK MODEL NUMBER	CAPACITY GALLONS (F)	SHIPPING WEIGHT	DIMENSIONS (INCHES)								
				OVERALL								
				A	B	C	D	E	G	H	I	J
GCKA 5	RT70	70	167	24	30	28	12	23	1	2	1/2	6 1/2
GCKA 7 1/2	RT70	70	167	24	30	28	12	23	1	2	1/2	6 1/2
GCKA 10	RT70	70	167	24	30	28	12	23	1	2	1/2	6 1/2
GCKA 15	RT100	100	190	24	33	34	12	26 1/2	1 5/8	3	1/2	7 1/2
GCKA 20	RT100	100	190	24	33	34	12	26 1/2	1 5/8	3	1/2	7 1/2
GCKA 25	RT200	200	290	30	54	36	15	28 1/2	1 3/4	4	3/4	7 1/2
GCKA 30	RT200	200	290	30	54	36	15	28 1/2	1 3/4	4	3/4	7 1/2
GCKA 40	RT300	300	450	30	54	51	15	43	1 3/4	4	3/4	7 1/2
GCKA 50	RT300	300	450	30	54	51	15	43	1 3/4	4	3/4	7 1/2
GCKA 60	RT300	300	450	30	54	51	15	43	1 3/4	4	3/4	7 1/2
GCKA 75	RT500	500	610	48	70	42	24	34	1 3/4	4	3/4	7 1/2
GCKA 100	RT500	500	610	48	70	42	24	34	1 3/4	4	3/4	7 1/2
GCKA 120	RT750	750	890	60	60	56	30	48	2	6	3/4	8 3/8
GCKA 150	RT1000	1000	1030	60	72	64	30	53	2	6	3/4	8 3/8

TABLE 4 • CENTRIFUGAL PUMPS • MODELS H5 AND H9

When specifying a cooling tower, remember that H&M offers pumps for all cooling towers. Refer to H&M Bulletin HWP-101.

COOLING TOWER MODEL NUMBER	GPM STD. WATER FLOW	PUMPING HEADS													
		15 ft		30 ft		40 ft		50 ft		60 ft		75 ft		100 ft	
		HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER	HP	H&M MODEL NUMBER
GCKA 5	15	1/3	1" -H5C2	1/3	1" -H5C2	1/3	1" -H5C2	1/2	1" -H5C2	3/4	3/4" -H5A2	1	3/4" -H5A2	1 1/2	3/4" -H5A2
GCKA 7 1/2	22.5	1/3	1" -H5C2	1/3	1" -H5C2	1/3	1" -H5C2	1/2	1" -H5C2	3/4	3/4" -H5A2	1 1/2	3/4" -H5A2	1 1/2	3/4" -H5A2
GCKA 10	30	1/3	1" -H5C2	1/3	1" -H5C2	1/2	1" -H5C2	1	3/4" -H5A2	1	3/4" -H5A2	1 1/2	3/4" -H5A2	3	1" -H9D2
GCKA 15	45	1/3	1 1/2"-H5C2	1/2	1 1/2"-H5C2	3/4	1 1/2"-H5C2	1	1 1/2"-H5C2	1 1/2	3/4" -H5A2	2	1" -H5D2	5	1" -H9D2
GCKA 20	60	1/3	1 1/2"-H5C2	1/2	1 1/2"-H5C2	1	1 1/2"-H5C2	1	1 1/2"-H5C2	2	1" -H5A2	3	1" -H9D2	5	1" -H9D2
GCKA 25	75	1/2	1 1/2"-H5C2	3/4	1 1/2"-H5C2	1	1 1/2"-H5C2	1 1/2	1 1/4"-H5B2	2	1 1/4"-H5B2	5	1 1/4"-H9D2	5	1 1/4"-H9D2
GCKA 30	90	1/2	1 1/2"-H5C2	1	1 1/2"-H5C2	1 1/2	1 1/4"-H5B2	1 1/2	1 1/4"-H5B2	3	1 1/4"-H9D2	5	1 1/4"-H9D2	5	1 1/4"-H9D2
GCKA 40	120	1	1 1/2"-H5C2	1 1/2	1 1/4"-H5B2	2	1 1/2"-H9B2	3	1 1/4"-H9D2	5	1 1/4"-H9D2	5	1 1/4"-H9D2	5	1 1/4"-H9D2
GCKA 50	150	2	2 1/2"-H9E2	3	2 1/2"-H9E2	3	2 1/2"-H9E2	5	2" -H9D2	5	2" -H9D2	7 1/2	2" -H9D2	7 1/2	2" -H9D2
GCKA 60	180	2	2 1/2"-H9E2	3	2 1/2"-H9E2	5	2" -H9D2	5	2" -H9D2	5	2" -H9D2	7 1/2	2" -H9D2	7 1/2	2" -H9D2
GCKA 75	240	2	2 1/2"-H9E2	3	2 1/2"-H9E2	5	2 1/2"-H9D2	5	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	10	2" -H9D2
GCKA 100	300	3	2 1/2"-H9E2	5	2 1/2"-H9D2	5	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	10	2 1/2"-H9D2
GCKA 120	360	5	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	7 1/2	2 1/2"-H9D2	10	2 1/2"-H9D2	15	2" -H9D2
GCKA 150	450	–	—	–	—	–	—	–	—	10	2 1/2"-H9D2	10	2 1/2"-H9D1	15	2 1/2"-H9D2

For more information, write or call Halstead & Mitchell, A Division of Halstead Industries Inc., Scottsboro, Ala. 35768. (205) 259-1212.

Halstead & Mitchell
A DIVISION OF HALSTEAD INDUSTRIES INC.

COOLING TOWER PUMP

OPERATING INSTRUCTIONS & PARTS LIST

CENTRIFUGAL PUMP

MODELS 3P604, 3P605, 3P606, 3P607 & 3P608

FORM 5S1407
1615

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

0179/495/25C
2ABC

ATTENTION: READ THIS PUBLICATION CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THE TEEL CONTRIFUGAL PUMP. RETAIN FOR FUTURE REFERENCE!

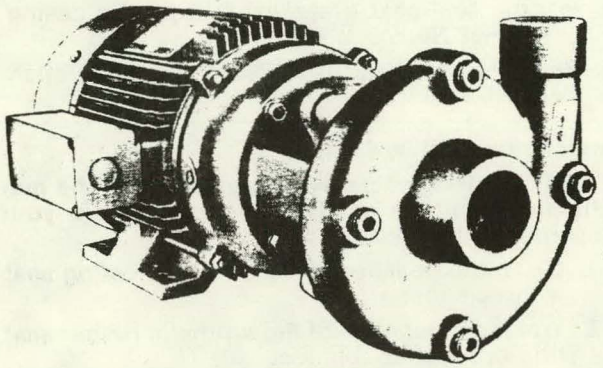


Figure 1 — Models 3P604, 3P606 and 3P608

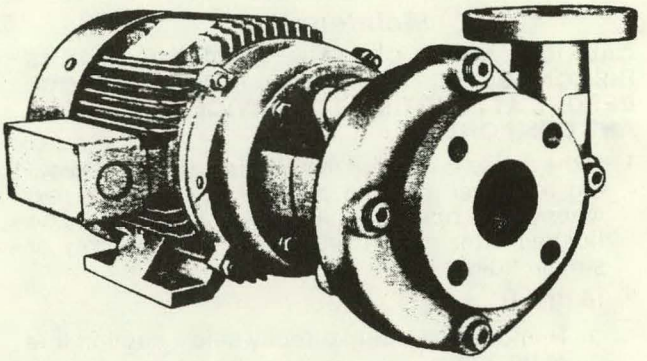


Figure 2 — Models 3P605 and 3P607

Description

The Teel centrifugal pump is a non-self priming unit designed to handle liquid transfer and heating and cooling applications. The unit is equipped with a cast iron pump casing designed with full dual volute, clog resistant semi-open bronze impeller and a totally enclosed fan cooled electric motor. A mechanical seal isolates the motor from the liquid in the pump casing. The discharge port on the pump casing can be adjusted in 90° increments to accommodate the specific application.

Models 3P604, 3P606 and 3P608 are equipped with a pump casing to accommodate threaded suction and discharge piping connections. The pump casing used with Models 3P605 and 3P607 accommodates flange type suction and discharge piping connections.

WARNING: Do not use to pump flammable or explosive fluids such as gasoline, fuel oil, kerosene, etc. Do not use in explosive atmospheres. Failure to follow this warning can result in property damage and/or personal injury.

Specifications

Threaded suction inlet .....2" NPT
Flanged suction inlet .....2"
Threaded discharge outlet .....1½" NPT
Flanged discharge outlet .....1½"
RPM 3600
Power supply .....230/460 volts, 60 Hz, 3 phase

Specification and Performance Chart

Model	wt. (lbs)	HP	Pump Casing Type	Dimensions H	W	L	Gallons Per Minute at Pump Head in Feet 10'	20'	30'	40'	50'	60'	70'	80'	90'	100'	110'
3P604	115	2	Threaded	8¼"	10½"	18⅜"	170	150	130	100	65	25	—	—	—	—	—
3P605	151	3	Flanged	9¼"	13¼"	20⅝"	—	—	165	145	125	95	60	15	—	—	—
3P606	173	3	Threaded	9¼"	12"	20⅝"	—	—	165	145	125	95	60	15	—	—	—
3P607	166	5	Flanged	9¾"	13¼"	22"	—	—	—	—	200	185	165	145	120	90	50
3P608	180	5	Threaded	9¾"	12"	22"	—	—	—	—	200	185	165	145	120	90	50

Operation (Continued)

WARNING: *Do not run pump dry as permanent damage to the mechanical seal will result.*

4. Activate the unit.

   IMPORTANT: Power should be applied momentarily to the pump at first and the direction of rotation checked. When viewing the rear of the motor (opposite the pump end), the motor shaft should be rotating clockwise. If it is not, disconnect power and re-check wiring to motor. (See "Installation" section.)

   NOTE: Never shut-off discharge or restrict suction flow while the pump is operating.

Maintenance

CAUTION: MAKE CERTAIN THAT THE UNIT IS DISCONNECTED FROM THE POWER SOURCE BEFORE ATTEMPTING TO SERVICE OR REMOVE ANY COMPONENT!

1. If the pump is located in an area subject to freezing temperatures, the pump should be drained when not in operation. Also, the pump should be flushed after each use, if used with gummy or similar fluids.
2. to drain:
   a. Remove drain plug directly below suction line of the pump.
   b. Remove another drain plug to vent.

      NOTE: The vent plug will be considered the uppermost drain plug on the pump casing.

   c. Drain suction pipe to a point below the frost line.
   d. Drain all piping exposed to freezing temperatures.
3. All pumps are provided with shielded, prelubricated, ball bearings in the motor. Normally, relubrication of the bearings is not required.
4. The pump casing should be removed and inspected periodically to insure that any foreign material or rust are not clogging internal pump parts.

   NOTE: This unit is equipped with a dual volute pump casing. One of the volutes runs 180°, all the way from the side opposite the discharge into the discharge through a completely enclosed passageway. If foreign material clogs this area, it can be dislodged by using a wire or long spring.

Removal of Old Seal:

Should the mechanical seal, which consists of seal seat (Ref. No. 7) and seal cartridge (Ref. No. 9), require replacement, proceed as follows and refer to Figure 3.

IMPORTANT: *Always replace BOTH the seal seat and the seal cartridge to insure proper mating of components!*

1. Remove the four bolts (Ref. No. 4) that connects the casing cover (Ref. No. 5) to the casing (Ref. No. 14).
2. Remove the casing.

   CAUTION: Care should be taken not to "pinch" or "shave" the casing gasket (Ref. No. 6) and the "O" ring between the casing cover and the casing.
3. Using an Allen wrench remove the impeller lock bolt (Ref. No. 13), the lead seal washer (Ref. No. 12), and the impeller (Ref. No. 11).

   IMPORTANT: Care should be taken to insure that the same number of shim washers (Ref. No. 10) are replaced behind the impeller as were removed. These shim washers are located directly behind impeller. These washers as well as the impeller key (Ref. No. 2) become loose as the impeller is removed.
4. The seal cartridge (Ref. No. 9) and shaft sleeve (Ref. No. 8) can now be pulled from the shaft.
5. Pry the seal seat (Ref. No. 7) from the casing cover (Ref. No. 5).
6. Push the seal head (Ref. No. 9) from the shaft sleeve (Ref. No. 8).

Installation of New Seal:

CAUTION: The precision lapped faces on the mechanical seal are easily damaged. Handle your replacement seal carefully.

1. Clean the polished surface of the floating seat with a clean rag.
2. Wet the outer edge of the synthetic rubber seat ring with a soap solution.
3. Press the seat into the cavity firmly and squarely with *finger pressure only*. If the seat will not locate properly, place a cardboard washer over the polished surface and use a piece of standard pipe for pressing purposes.
4. Dispose of the cardboard washer. Check again that the polished surface is free of dirt or foreign particles and has not been scratched or damaged.
5. Thoroughly clean the outside of the shaft sleeve.
6. Push the new seal bellows onto the shaft sleeve.
7. Inspect the shaft and the inside of the shaft sleeve. Be sure that they are clean.
8. Clean the face of the carbon washer on the sealing end of the bellows.
9. Slide the shaft sleeve with the bellows assembly mounted on it onto the shaft.
10. Replace the shim washers. (See "Shim Adjustment" section.)
11. Replace the impeller key (Ref. No. 2) and impeller (Ref. No. 11). Do not forget to replace the lead impeller seal washer (Ref. No. 12) when screwing the impeller lock bolt (Ref. No. 13) in place.
12. Reassemble the rest of the pump.

Shim Adjustment:

When installing a replacement impeller (Ref. No. 11) or motor (Ref. No. 1), it may be necessary to adjust the number of shims (Ref. No. 10) to insure proper running clearance between the impeller and the casing. Proceed as follows:

NOTE: *A proper running clearance is less than 0.010"*

1. For impeller replacement, add one (1) shim in addition to the one (1) removed originally.

Maintenance (Continued)

2. For motor replacement, add two (2) shims in addition to the shims removed during disassembly.
3. Reassemble the pump as described in Steps 11 and 12. (See "Installation of New Seal" section).

IMPORTANT: *Insure that the casing is snugly in place and check the shaft to make sure it is turning freely (use the screwdriver slot in the motor to turn the shaft). If it turns freely, check to insure that the casing cover and casing are fitted "metal to metal" where they meet on the outside. If they are not "metal to metal", tighten the fasteners (Ref. Nos. 4 and 16) and recheck the shaft for free turning. Tighten carefully, turning the shaft while tightening so that the motor bearings are not damaged in the event that too many shims were installed. If shaft seizes before fasteners are completely tight, disassemble the pump and remove one (1) shim and repeat reassembly.*

Trouble Shooting Chart

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
No liquid delivered.	1. Pump not primed. 2. Speed too low. 3. Air leak in suction. 4. Discharge head too high. 5. Suction lift too high. 6. Impeller plugged. 7. Wrong direction of rotation.	1. Prime pump. 2. Check voltage. 3. Repair or replace. 4. Lower the height. 5. Lower the height. 6. Clean out. 7. Change direction.
Not enough liquid delivered.	1. Air leaks in suction. 2. Speed too low. 3. Discharge head too high. 4. Suction lift too high. 5. Impeller partially plugged. 6. Not enough suction head for hot liquid. 7. Impeller or casing damaged. 8. Suction not submerged enough.	1. Repair or replace. 2. Check voltage. 3. Lower the height. 4. Lower the height. 5. Clean out. 6. Increase suction head. 7. Replace. 8. Submerge suction.
Not enough pressure.	1. Speed too low. 2. Air or gas in liquid or leaks in suction. 3. Impeller damaged or partially plugged. 4. Pumped liquid has too much solid material mixed with it.	1. Check voltage. 2. Repair or replace suction line. 3. Clean or replace. 4. Add strainer.
Pump works for a while then loses suction.	1. Leaky suction line. 2. Suction lift too high. 3. End of suction line uncovered. 4. Air leaks in suction.	1. Repair or replace. 2. Lower the height. 3. Submerge end of suction line. 4. Repair or replace suction line.
Motor runs hot.	1. Liquid heavier and more viscous than water. 2. Seal binding 3. Rotor binding. 4. Voltage and frequency lower than rating. 5. Defects in motor.	1. Consult factory. 2. Replace. 3. Repair or replace. 4. Reconnect to rated voltage and frequency. 5. Repair or replace.
Seal leaks.	1. Corrosion due to character of liquid pumped. 2. Excessive amounts of abrasive material in liquid causing an accumulation around the rotating assembly which results in faces opening up and allowing grit between them.	1. Consult factory. 2. Consult factory.

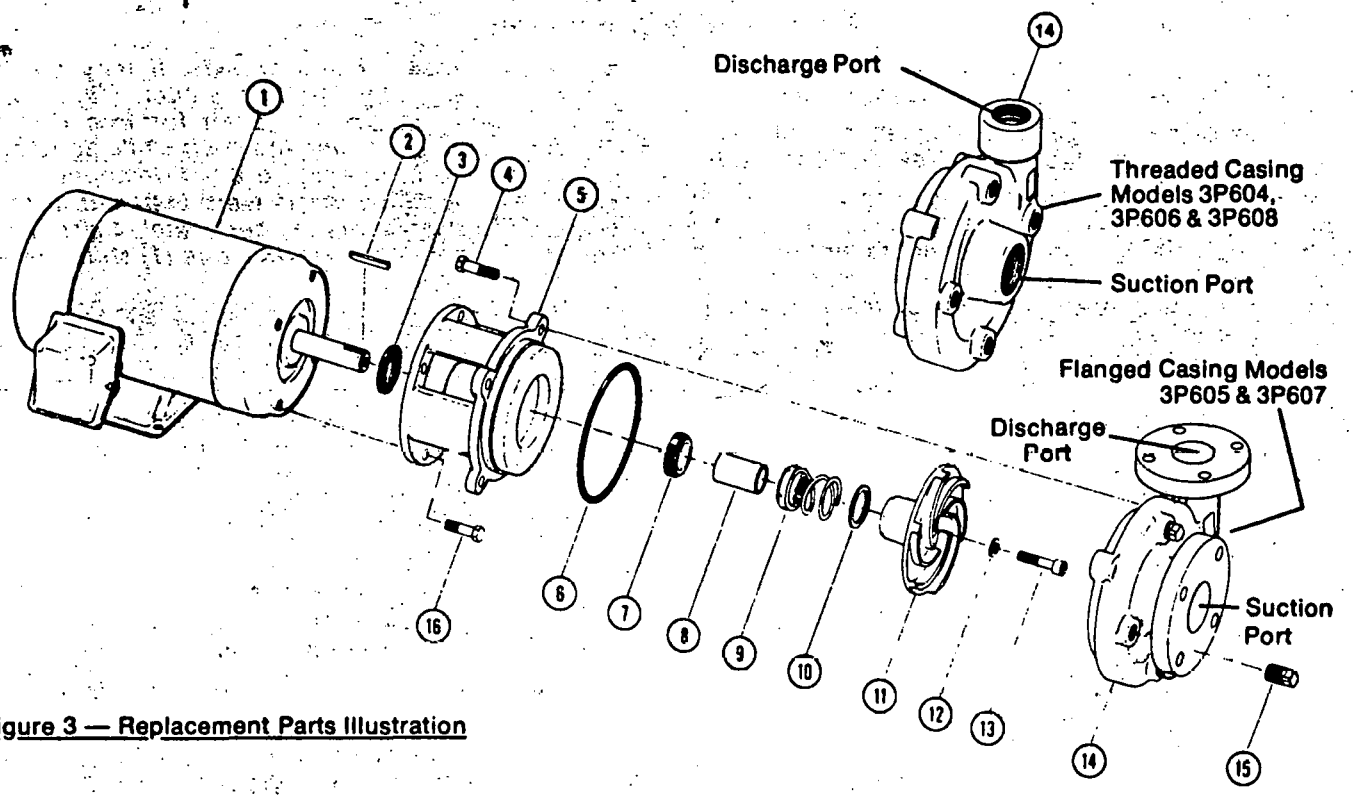


Figure 3 — Replacement Parts Illustration

Replacement Parts List

Ref. No.	Part No.	Description
1	9N058 or 9N084	Motor 2 HP (Model 3P604)
	9N059 or 9N085	Motor 3 HP (Models 3P605 and 3P606)
	9N060 or 9N086	Motor 5 HP (Models 3P607 and 3P608)
2	1471. 30	Impeller key
3	1470.93	Flinger washer
4	*	Hex hd. cap screw (4), ⅜-16 x 1¼
5	1470.01	Casing cover
6	1470.10	Gasket
7	1654.00	Seal seat, Buna N
	1642.00	Seal seal, Viton (Optional)
8	1472.00	Shaft sleeve
9	1655.00	Seal cartridge, Buna A
	1645.00	Seal cartridge, Viton (Optional)
10	1656.00	Impeller shims
11	1470.9901	Impeller - 2 HP (Model 3P604)
	1471.0002	Impeller - 3 HP (Models 3P605 and 3P606)
	1471.0001	Impeller - 5 HP (Models 3P607 and 3P608)
12	1471.20	Impeller seal washer
13	1757.10	Impeller lock bolt, S.S. sock. hd. cap scr., ⅜-16 x 1¼
14	1469.00	Casing (flange, Models 3P605 and 3P607)
	1470.00	Casing (threaded, Models 3P604, 3P606 and 3P608)
15	*	Drain plug (4) ½ NPT sock, hd.
16	*	Hex hd. cap scr. (4), ⅜-16 x 1

*Standard hardware items which can be purchased locally.

ORDER REPLACEMENT PARTS THROUGH DEALER FROM WHOM PRODUCT WAS PURCHASED

Please provide following information:

- Model Number
- Serial Number (if any)
- Part Description and Number as shown in Parts List.

If dealer cannot supply, order from:

Dayton Electric Mfg. Co.
CUSTOMER SERVICE DEPT.
5959 W. Howard St.
Chicago, Illinois 60648

LIMITED WARRANTY

Teel pumps, Models 3P604 thru 3P608, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use (rental use excluded), for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be repaired or replaced at Dayton's option. For warranty claim procedures, see "Prompt Disposition" below. This warranty gives purchasers specific legal rights, and purchasers may also have other rights which vary from state to state.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, express or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton, and Dayton's liability in all events is limited to the purchase price paid.

Certain aspects of disclaimers are not applicable to consumer products: e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. For any product believed to be defective within warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. If product was damaged in transit to you, file claim with carrier.

**DAYTON ELECTRIC MFG. CO., 5959 W. HOWARD ST.
CHICAGO, ILLINOIS 60648**

General Safety Information

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
2. Replace or repair damaged or worn cord immediately.
3. Protect the power cable from coming in contact with sharp objects.
4. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces, or chemicals.
5. Make certain that the power source conforms to the requirements of your equipment.
6. Always disconnect power source before performing any work on or near the motor or its connected load. If the power disconnect point is out-of-sight, lock it in the open position and tag it to prevent unexpected application of power. Failure to do so could result in fatal electrical shock!
7. Do not handle the pump with wet hands or when standing in water as fatal electrical shock could occur. Disconnect main power before handling unit for **ANY REASON!**
8. Motor must be securely and adequately electrically grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the motor frame, or other suitable means.

Unpacking

When unpacking the unit, inspect carefully for any damage that may have occurred during transit. Check for loose parts, missing parts or damaged parts.

Installation

1. Locate pump as close to the fluid source as possible, thus, making the suction line as short and direct as possible. **Unit is not self priming.**
2. The pump should be placed in an area where the ambient temperature will not exceed 40°C (104°F) and it is protected from extremes of cold, heat and humidity. Allow ample space for future maintenance and repair should it become necessary.
3. If necessary, adjust discharge port on the casing (Ref. No. 14) as follows using Figure 3 for reference:
   a. Unthread four fasteners (Ref. No. 4) from casing cover (Ref. No. 5) and gently remove casing (Ref. No. 14) from the casing cover.
   b. Rotate casing so that the discharge port is in the position desired.

      NOTE: Pump performance will not be affected by the position of the discharge port.
   c. Reassemble the casing to the casing cover by threading the four fasteners into the casing cover and casing.

      CAUTION: Do not overtighten the four fasteners which secure casing to the casing cover.
4. Mount unit on a solid foundation and secure with appropriate fasteners.
5. Attach piping suction line to suction inlet and piping discharge line to discharge outlet. Avoid using looped sections of pipe or fittings which might permit air to become trapped. Use pipe dope to insure air tight pipe connections.

   IMPORTANT: If plastic or fabric hose is used for the suction piping, it should be of a reinforced type so as not to collapse under suction. The suction piping should be one size larger than the discharge piping.
6. Support the piping independently of the pump to avoid universal or excessive stresses on the pump casing which would cause impeller misalignment and possible pump failure.
7. Install both a union and a gate valve (not furnished) on the discharge side of the pump for service convenience.

   CAUTION: Do not use a globe or other restricting type of valve at the discharge. Globe valves seriously restrict the capacity of the pump.
8. It is mandatory that a foot valve be used on the suction line to assure quick priming and that a suitable suction strainer be attached to the suction line so that large pieces of foreign material are not drawn into the pump.

   IMPORTANT: The foot valve must be located below the free level of the liquid in suction.
9. Wiring:
   a. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
   b. Motor must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the motor frame, or other suitable means.
   c. Connections should be made with flexible conduit to minimize vibration transmission.
   d. Use wire of adequate size to minimize voltage drop at the motor. DOUBLE CHECK ALL CONNECTIONS. (Refer to wiring diagram on motor nameplate.)

      WARNING: MOTOR IS DESIGNED FOR 60 Hz., 3 PHASE POWER ONLY!
10. Inspect impeller for proper rotation. When viewing the rear of the motor (opposite the pump end), the motor shaft should rotate clockwise.

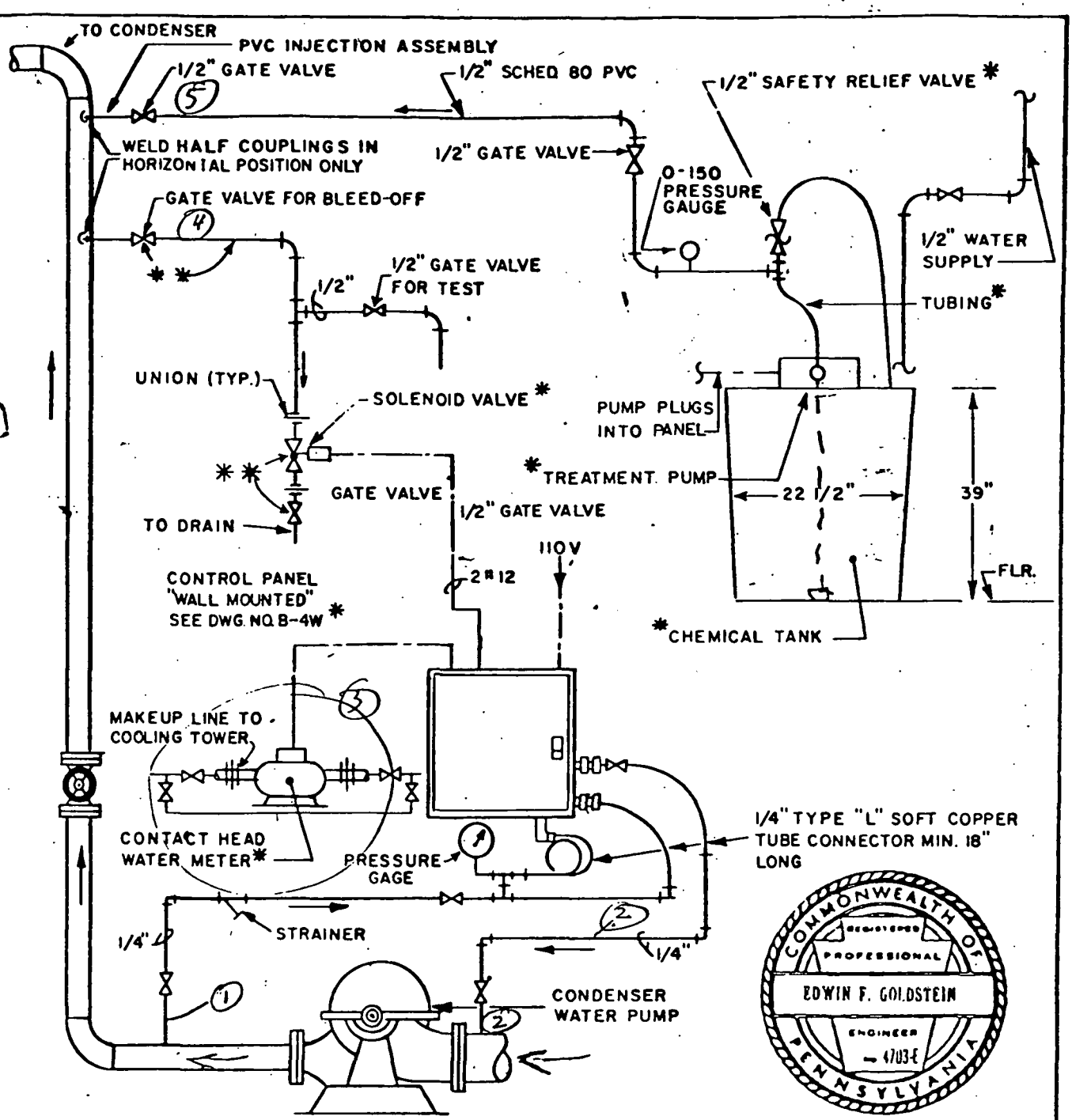
    IMPORTANT: Proper impeller rotation direction is critical for centrifugal pumps. The interchanging of any two wires will change rotation direction.
11. Install auxiliary components (e.g. — pressure switch, timer, etc.).

Operation

1. The casing and suction piping must be filled with liquid before the unit can begin pumping.
2. In order to completely fill casing with liquid, entrapped air in casing must be vented. This is accomplished by removing the top drain plug located on the casing.
3. Prime the pump by filling the casing with liquid through the top drain plug.

COOLING TOWER

TREATMENT SYSTEM



COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
EDWIN F. GOLDSTEIN
ENGINEER
4703-E

7/3/80

DRAWING B-4-A

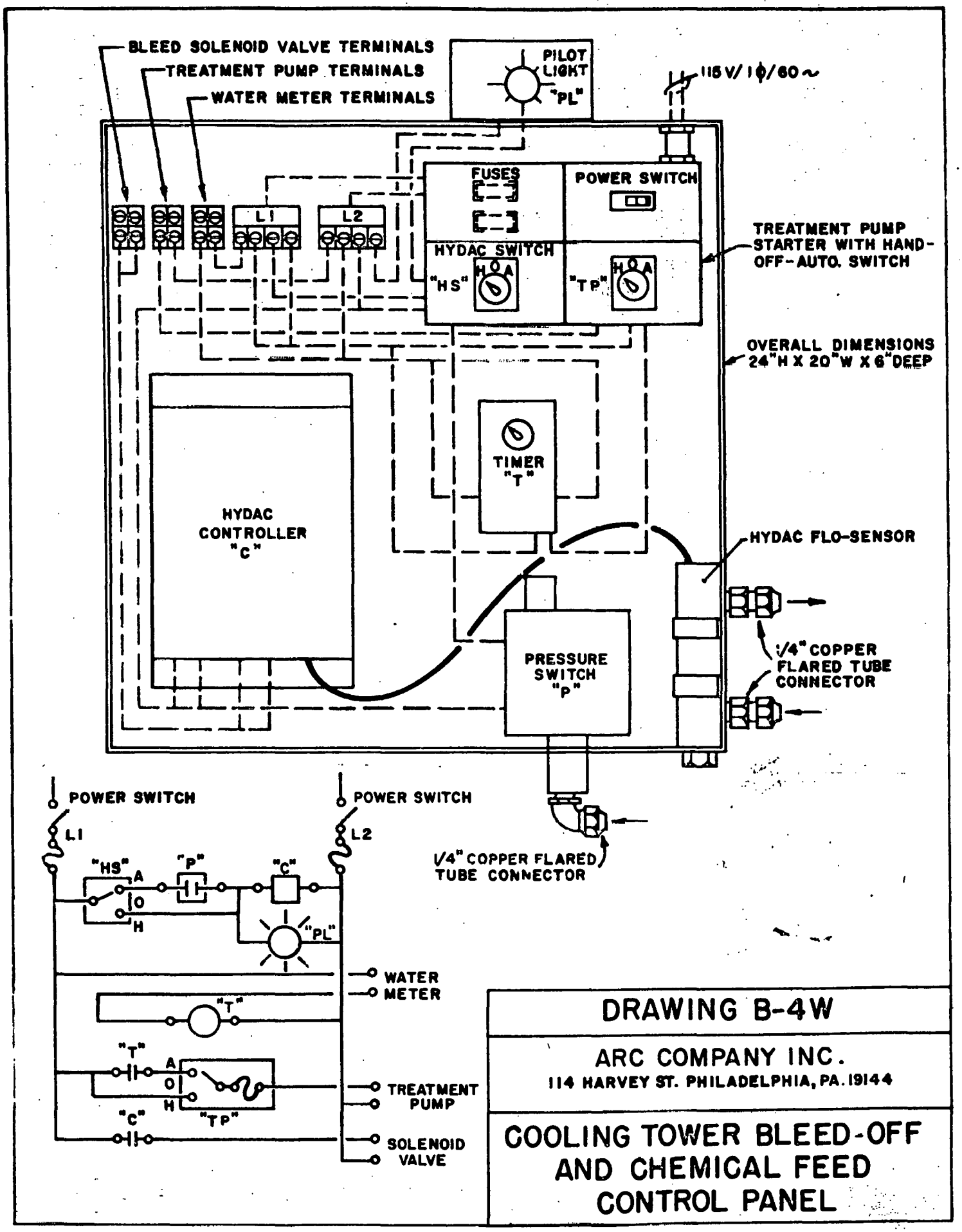
ARC COMPANY INC.

114 HARVEY ST. PHILADELPHIA, PA., 19144

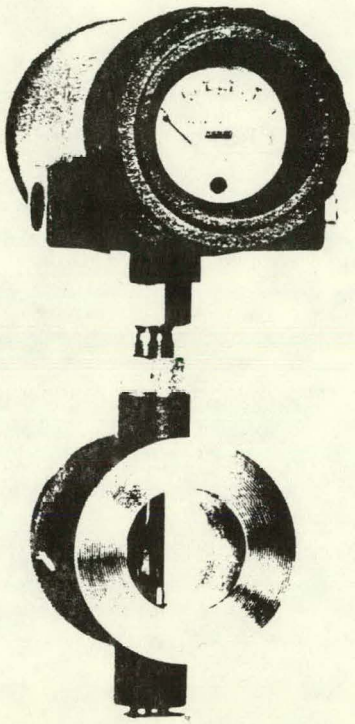
COOLING TOWER CHEMICAL FEED SYSTEM FULLY AUTOMATED

* EQUIPMENT FURNISHED BY ARC CO.

* * COOLING TOWER CAPACITY - TONS 1/2" UP TO 300, 3/4" 300 TO 1000, 1" OVER 1000


BLEED SOLENOID VALVE TERMINALS
TREATMENT PUMP TERMINALS
WATER METER TERMINALS
PILOT LIGHT "PL"
115 V/1 ϕ/60 ~
FUSES
POWER SWITCH
L1
L2
HYDAC SWITCH
"HS"
"TP"
TREATMENT PUMP STARTER WITH HAND-OFF-AUTO. SWITCH
OVERALL DIMENSIONS 24"H X 20"W X 6"DEEP
TIMER "T"
HYDAC CONTROLLER "C"
HYDAC FLO-SENSOR
PRESSURE SWITCH "P"
1/4" COPPER FLARED TUBE CONNECTOR
1/4" COPPER FLARED TUBE CONNECTOR
POWER SWITCH
L1
POWER SWITCH
L2
"HS"
"P"
"C"
"PL"
"T"
"T"
"C"
"TP"
WATER METER
TREATMENT PUMP
SOLENOID VALVE
DRAWING B-4W
ARC COMPANY INC.
114 HARVEY ST. PHILADELPHIA, PA. 19144
COOLING TOWER BLEED-OFF AND CHEMICAL FEED CONTROL PANEL

FLOW METERS



E83 LIQUID VORTEX FLOWMETER

The E83 Series Vortex Flowmeter has the advantages of wide rangeability, high accuracy and low installation cost to make it an excellent choice for a wide variety of liquid flow measurement applications.

INTRODUCTION

The E83 Series Vortex Flowmeter, as shown above, measures liquid flow rates using the principle of vortex shedding. The transmitter produces either an electronic analog or pulse rate signal linearly proportional to volumetric flow rate.

Liquid flowing through the meter housing passes a specially-shaped vortex element which causes vortices to form and shed (separate) from alternate sides of the element at a rate proportional to the flow rate of the liquid. These shedding vortices create an alternating differential pressure which is sensed by a detector located in the "tail" of the vortex generator. An ac voltage signal is produced in the flowmeter with a frequency synchronous with the vortex shedding frequency.

CONTENTS . . .

Introduction

Principle of Operation

Instrument Description

Vortex Flowmeter Characteristics

Cavitation

Pressure Loss

FOXBORO

RELIEF VALVES

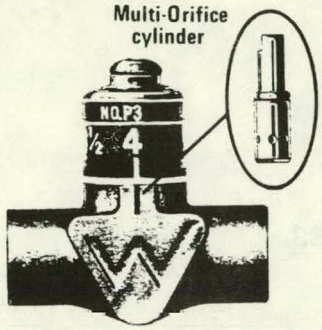
A. Berm - 2" x 2" #174A

B. Boiler - 1¼" x 1¼" #174A

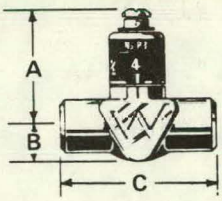
C. Sub-Arrays - ½" #5300A

No. P3

Multi-Orifice Flow Controls for Tankless Heaters
Adjusts to 2½, 3, 3½ or 4 GPM
Max. Temperature 250°F.
Max. Pressure 150 psi.



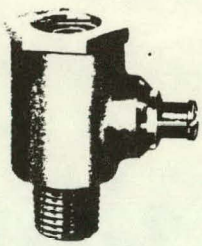
Watts Flow Control valves are designed to limit the flow of water to equipment and are ideally used for tankless heater installations. Features a multi-orifice design which lets you select desired flows at 50 psi (as shown above) simply and quickly by turning the cap to the required setting. Setting is obtained by locating multi-orifice cylinder adjusting cap to the marking over the matching line on the body. For other pressures and flow capacities see instruction sheet.



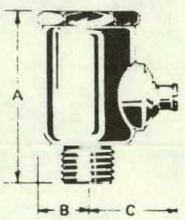
No.	Size	Dimensions A	B	C	Wgt (oz.)
P3	1/2"	1 5/8"	1/2"	2"	6

No. TC (Replaces former No. P2)

Multi-purpose "Ball" Type Valve
For Use as Test Cocks,
Balancing, Shut-off or Drain.



No. TC is an efficient, dependable, positive, "ball" type shut-off valve for liquids. It has a brass ball that rotates smoothly against a "Teflon" seat for positive open or closed position. The ball cleans and lubricates itself as it is rotated—no sticking. Flow can be controlled by partial rotation of the ball. A female screwed outlet connection provides easy attachment of test hoses. etc.



No.	Size N.P.T.	DIMENSIONS A	B	C	Wgt. (oz.)
TC-1	1/8"	1 3/4"	1/2"	7/8"	3 1/2
TC-2	1/4"	1 3/4"	1/2"	7/8"	3 1/2
TC-4	1/2"	1 7/8"	1/2"	7/8"	4
TC-6	3/4"	2"	5/8"	7/8"	5

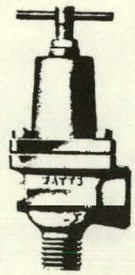
No. BP30 Series

Diaphragm Operated Relief Valve

By-Pass Control Valves

Diaphragm actuated by-pass relief valves to regulate liquid pressure as supplied by a positive pressure pump. Protects equipment by opening at desired setting and allowing excess volume to be by-passed back to source. Construction is bronze body. Sensitive rubber diaphragm and special **Teflon** disc. Furnished with T handle to facilitate pressure change. Spring and adjustment handle free from contact with liquid elements being controlled.

Max. Temperature 180°F. Size: ½".



No. BP30

PRESSURE RANGES

Series BP30	Ordering Code
10-50	BP30A
45-100	BP30B
75-175	BP30C

No.	Size	Height	Length	Weight
BP30	1/2"	5 3/4"	2 1/4"	1 1/8 lbs.

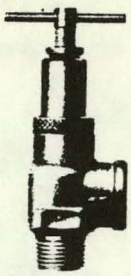
No. 5300A

Poppet Type Relief Valve

For By-Pass Service

Compact, low cost, poppet type by-pass valve for low capacity requirements. All bronze construction, stainless steel spring and **Teflon** disc. Stuffing box seals against leakage around adjustment "T" handle.

Pressure range: 35-175 lbs.
Size: ½"
Max. Temperature 180°F.
Max. Pressure 175 psi.

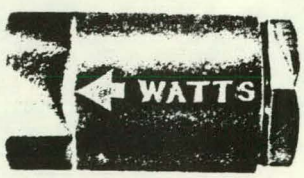


No. 5300A

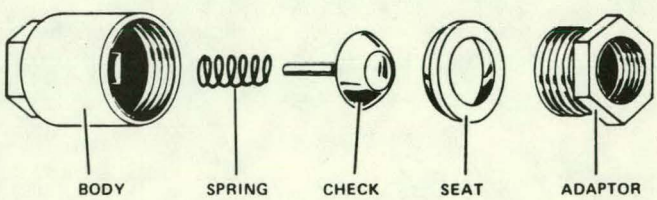
No.	Size	Height	Length	Weight
5300A	1/2"	4 1/2"	1 1/8"	3/4 lb.

No. 600 Series

"Maxi-Flo" Check Valve



The No. 600 is designed to allow full fluid flow. A highly machined brass disc with a "Teflon" seat assures tightest possible seating capacity. Stainless steel guide rod and spring for added strength and protection against corrosives. The valve can be installed horizontally or vertically. Easily replaceable seat and check assembly. Rated at 125 lbs. steam and 400 lbs. WOG.



No.	Size	Height	Length	Wgt. (lbs.)
600	1/4", 3/8", 1/2"	2 1/8"	1 1/4"	1/2
600	3/4"	2 1/2"	1 1/2"	3/4
600	1"	3 1/8"	2"	1 3/8
600	1 1/4"	3 3/4"	2 1/2"	2 1/8
600	1 1/2"	4"	2 3/4"	3
600	2"	4 1/2"	3 1/2"	4 3/8

FEATURES

- Low pressure drop equivalent to swing checks.
- Install in horizontal or vertical position.
- "Teflon" seat for tight positive seating.

No. 174A Series

A.S.M.E. Water Pressure Relief Valves



Bronze body relief valves for pressure protection only of all types of hot water heating boiler equipment. Pressure range 30 lbs. to 160 lbs. with corresponding high BTU/HR ratings from 650,000 to 14,370,000 BTU/HR. Female inlet and outlet connections. Sizes: ¾" to 2" inclusive.

- Seat located above drain: water can't be trapped and sediment can't foul seat
- Non-mechanical seat-to-disc alignment will not stick or freeze
- Water seal of high temperature resisting material isolates spring working parts from water during relief.

NOTE: For recommended Temperature and Pressure Protection of Domestic Hot Water Supply Systems, see page 14

No.	Size	Model	Height	Length	Weight
174A	3/4" x 3/4"	M3	5 1/8"	2 1/2"	1 1/2 lbs.
174A	1" x 1"	M1	5 3/4"	3"	3 1/8 lbs.
174A	1 1/4" x 1 1/4"	M1	8 3/8"	4 3/4"	6 1/4 lbs.
174A	1 1/2" x 1 1/2"	M	9"	4 7/8"	7 1/4 lbs.
174A	2" x 2"	M	11 5/8"	6 1/4"	13 3/4 lbs.

SETTINGS and RELIEVING CAPACITIES
(National Board Certified Ratings)
BTU Steam Discharge Capacities

Size	30 lbs.	100 lbs.	125 lbs.	150 lbs.
¾"	650,000	1,695,000	2,070,000	2,445,000
1"	1,005,000	2,635,000	3,215,000	3,795,000
1¼"	1,682,000	4,399,000	5,370,000	6,340,000
1½"	2,020,000	5,290,000	6,460,000	7,630,000
2"	3,815,000	9,970,000	12,170,000	14,370,000

NOTE: We recommend No. 740 Series as best buy for hot water space heating boiler requirements between 30 through 75 lbs.

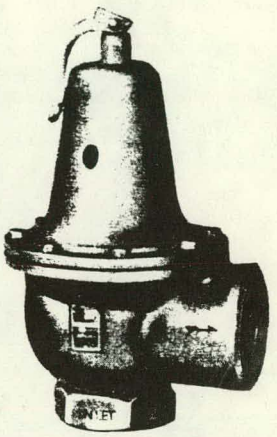
No. 174A and 740 are for protection against excessive water pressure caused by thermal expansion of the water. However, the valve also has an emergency BTU steam discharge capacity if run-away firing conditions occur, but do not use for steam service installations.

The function of the valve is to prevent excessive pressures above the valve setting, but valve will not prevent the natural build-up of temperature in the boiler because the valve works on pressure only and temperature does not affect its operation. Therefore, for domestic hot water supply systems, to prevent excessive temperature above 212°, which might result in overheating explosive dangers, combined temperature and pressure relief protection is essential.

Watts self-closing combination temperature and pressure relief valves give this protection as described on page 14.

No. 740 Series

A.S.M.E. Boiler Safety Water Relief Valves



Iron body relief valves with expanded outlets for hot water space heating boilers. Pressure range 30 lbs. to 75 lbs. with corresponding high ratings from 925,000 to 10,700,000 BTU/HR. This wide range of relieving capacities provides a much lower BTU per thousand cost because this series provides a much higher BTU rating, size for size, than other valves on the market. Female inlet and outlet connections. Sizes: ¾" to 2" inclusive.

- Same design features as No. 174A except for difference in body construction and material

No.	Size	Model	Height	Length	Weight
740	3/4" x 1"	M1	5 5/8"	3"	1 7/8 lbs.
740	1" x 1 1/4"	M	7 1/4"	3 1/2"	3 1/8 lbs.
740	1 1/4" x 1 1/2"	M	8 3/4"	4 5/8"	6 1/8 lbs.
740	1 1/2" x 2"	M	9 1/4"	5 1/4"	7 1/2 lbs.
740	2" x 2 1/2"	M	11 5/8"	6 3/4"	16 1/2 lbs.

SETTINGS and RELIEVING CAPACITIES
(National Board Certified Ratings)
BTU Steam Discharge Capacities

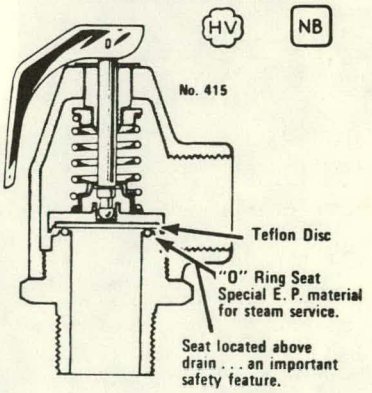
Size	30 lbs.	45 lbs.	50 lbs.	75 lbs.
¾" x 1"	925,000	1,245,000	1,352,000	1,886,000
1" x 1¼"	1,300,000	1,749,000	1,899,000	2,649,000
1¼" x 1½"	2,105,000	2,830,000	3,075,000	4,285,000
1½" x 2"	2,900,000	3,903,000	4,238,000	5,910,000
2" x 2½"	5,250,000	7,050,000	7,650,000	10,700,000

NOTE: Valve settings, other than shown above, are available in 5 lb. increments between the pressure range of 30 through 75 lbs.

Nos. 315, 415

A.S.M.E. Tested and Rated

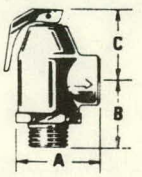
Steam Safety Valves
For Steam Service Installations



Watts No. 415 ASME rated Steam Safety Relief Valves up to 450 lbs./hr. have been developed to provide high quality dependable low cost protection for any low pressure steam heating equipment up to 15 lbs. They are also available with lower settings, such as 8 lbs. for pressure cooker requirements. Consult factory for rating and quotation.

These valves are designed with the seat elevated above the I.D. of a connected drain. This eliminates the need of "a body drain below seat level – in the valve or in the outlet piping", as required in ASME Section IV Article HG-401.1 Para. (h) providing, of course, a connected drain pipe is pitched down from the valve outlet.

This feature protects against potential injury from steam discharge and complies with the requirements of the Consumer Product Safety Act.



No.	Size	A.S.M.E. Steam Discharge Capacity Lbs./Hr. (Set 15 lbs.)	Dimensions A	B	C	Weight
315	3/4"x3/4"	300	1 3/4"	1 13/16"	1 3/4"	5/8 lb.
415	3/4"x3/4"	450	2 1/8"	1 13/16"	1 7/8"	1 lb.

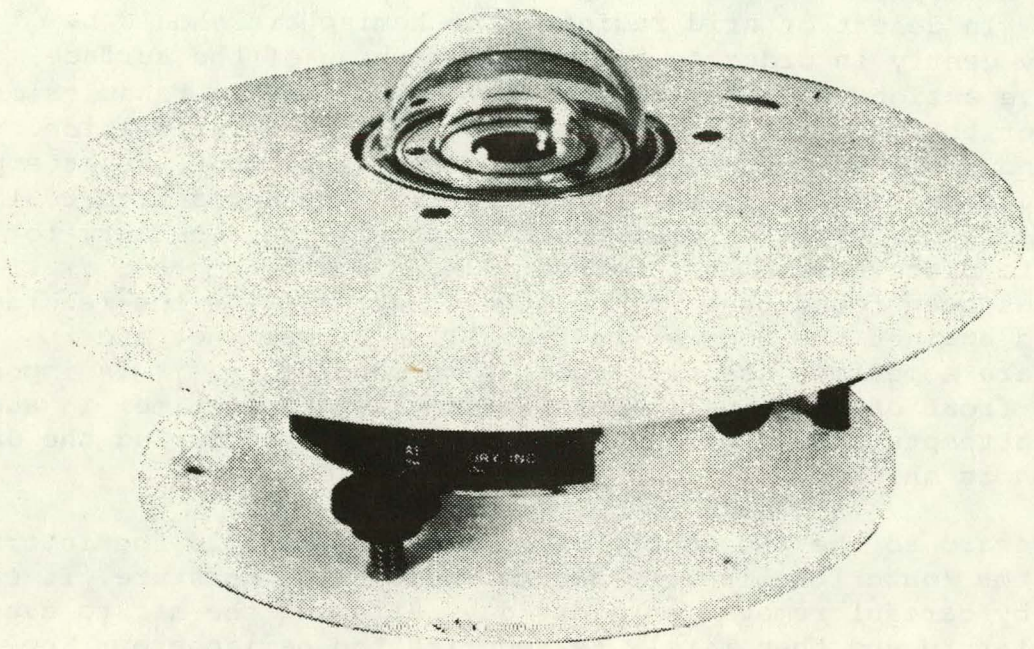
For Additional Detailed Information, send for Folder F-TP ASME

Insolation Detector

(Eppley Pyranometer)

EPPLEY PRECISION PYRANOMETER

Model PSP



INSTRUMENTS CHARACTERISTICS

Sensitivity	9 microvolts per watt meter^{-2} approx.
Impedance	650 ohms approx.
Receiver	circular 1 cm^{-2}, coated with Parsons' black optical lacquer
Temperature dependence	±1 per cent over ambient temperature range -20 to +40°C (temperature compensation of sensitivity can be supplied over other ranges at additional charge)
Linearity	±0.5 per cent from 0 to 2800 watts m^{-2}
Response time	1 second (i/e signal)
Cosine	±1 per cent from normalization 0 - 70° zenith angle ±3 per cent 70 - 80° zenith angle
Orientation	no effect on instrument performance
Mechanical vibration	tested up to 20g's without damage
Calibration	integrating hemisphere (approx. 1 cal cm^{-2} min^{-1}, ambient temperature +25°C): calibration reference Eppley primary standard group of Angstrom pyrheliometers repruducing the International Pyrheliometric Scale
Readout	potentiometric in preference to microammeter devices

Fig. 1

(c) Maintenance

Pyranometers and pyrgeometers in continuous operation should be inspected, ideally, at least once per day. At these inspections, the (outer) hemisphere should be wiped clean and dry with a lint-free soft cloth. In desert or arid regions, the hemisphere should be cleaned very gently in order to prevent scratching of the surface. Such abrasive action can alter appreciably the original transmission properties of the material and, hence, the radiometer calibration. If frozen snow, glazed ice, hoar frost or rime is present, an attempt should be made to remove, at least temporarily, the deposit carefully with warmed cloths. In the polar regions, it will be necessary to experiment to discover the best method of keeping radiometers frost free. It has been found that warm cloths (heated inside the recorder hut and held against the body while travelling between hut and instruments) are sometimes useful. Under some conditions, it is impossible to keep frost off the instruments for any length of time; in such instances, attempts should be made at convenient times during the day when the sun is shining.

With regard to the two models of pyranometer, should the internal surface of the (outer) hemisphere become coated with moisture, it can be cleaned by careful removal on a dry day, allowing the air to evaporate the moisture and then firmly re-securing the hemisphere. The inside of the hemisphere should not be wiped unless smears are visible. Precautions should be taken to avoid scratching the undersurface of the collar carrying this hemisphere. In the case of the precision spectral pyranometer, the external surface of the inner hemisphere can also be cleaned, if necessary, when the large one is removed. Should moisture be deposited on the inside of the small hemisphere, this can similarly be removed. However, in this instance, and also with removal of the single hemispherical envelope of the black and white model, extreme care must be exercised since the thermopile element is now unprotected and could be seriously damaged.

Occasionally, the desiccator installed in the pyranometer case should be inspected. Whenever the silica gel drying agent is pinkish or white in color, it should be replaced (N.B. silica gel can be rejuvenated by drying in an oven at about 135°C for a few hours, until the original dark blue color reappears).

The circular spirit level of the pyranometer or pyrgeometer should be inspected at regular intervals.

With regard to the pyrgeometer, the same maintenance procedures are applicable. However, care should be exercised when cleaning the external surface of the hemisphere since the protective coating on the KRS-5 material is vacuum deposited and, therefore, thin and fragile. The hemisphere should only be removed when calibration verification indicates that the results are suspect; in this instance, the interference filter (vacuum) deposited on the internal surface of the hemisphere must never be touched.

Although the external surface of the KRS-5 hemisphere of the pyrgeometer is treated to be impervious to weather effects, the coating may deteriorate in the course of time exposing the KRS-5 surface. In such an event, discoloration (in the extreme, a corrosive layer with rain in the presence of sea salt) may develop. However, this is more of a nuisance than a measurement problem, since tests, at Newport, have demonstrated that despite an obvious deterioration in the envelope transmission in the visible region, the infrared characteristics are not significantly affected. But, to avoid permanent damage to the hemisphere system, such impurities should be removed as soon as they are noticed. The recommended cleanser for uncoated KRS-5 is methyl ethyl ketone. In the case where such surface contamination cannot be so removed, the hemisphere can be reground, polished and coated by the Eppley Laboratory.

6. Readout Instrumentation

Recommended types of recording and integrating devices are described in the manufacturers' literature (obtainable on request from the Eppley Laboratory). Electronic strip-chart, millivolt potentiometric recorders (incorporating variable-range rheostats) are available, to permit the exact matching of the recorder scale to any specific pyranometer on pyrgeometer sensitivity and so yielding chart deflections expressed directly either in the cal cm^{-2} min^{-1} or the mW cm^{-2} unit. Built-in integrators with visually-read digital display and also auxiliary print-out equipment can be supplied with these recorders. Standard types of digital voltmeter are likewise suitable. With low irradiance values, particularly in the infrared, it is sometimes convenient to increase the read-out resolution of the records, by use of a pre-amplifier, to reproduce a pyrgeometer calibration accuracy of ±3 per cent or better. The readout instrumentation employed should be firmly mounted, either in a panel assembly or on an inside wall of the room where it is to be located. On account of the relatively high impedance of Eppley pyranometers and pyrgeometers, they are not suitable for use with microammeters.

URETHANE FOAM

Stepan Company | Urethane Department | Telephone 312 446 7600

Technical Information Bulletin

STEPANFOAM™ BX-350-7

RIGID URETHANE FOAM SYSTEM

DESCRIPTION: The Stepanfoam BX-350-7 is designed as a spray system for use as thermal insulation in panels, cavities and roofing applications. This system has been designed to give a very smooth surface on horizontal and inclined roofing applications. The BX-350-7 foam can be applied to plywood, steel, concrete and other various substrates at temperatures of 60-100°F.

PHYSICAL CHARACTERISTICS: The Stepanfoam BX-350-7 is a low viscosity system specifically formulated to offer the maximum compatibility and ease of atomization necessary for spray applications. The reactivity of BX-350-7 at a hose temperature of 130-140°F. and a block temperature of 150-160°F. will give a tack free time (set time) of 7 seconds.

Viscosity @ 73°F.:	R Component	350-400 cps
	T Component	150-200 cps
Specific Gravity:	R Component	1.208
	T Component	1.235
Foam Ratio by Volume:	R Component	50%
	T Component	50%

PHYSICAL PROPERTIES:

Density, pcf, core	2.7
Compressive Strength, 10% Strain, psi	
Parallel	42 - 48
Perpendicular	25.0
K Factor, Thermal Probe (BTU-in/hr.sq.ft.°F.)	
Initial	0.114
7 days @ 140°F.	0.120
30 days @ 77°F.	0.125
Dimensional Stability, % Volume Change	
1 day @ 200°F.	1.5
1 day @ 110°F. 100% RH	0.7
7 days @ 158°F. and 100% RH	11.3
14 days @ 158°F. and 100% RH	14.6
7 days @ -20°F.	0.9

The above data should be used as a guide only in the preparation of material specifications since foam properties are dependent upon processing conditions.

(over)

All polyurethane foam burns in varying degrees which in turn liberates toxic gasses and should be evaluated in its final form on meeting existing standards in your industry.

The information presented herein is based on our own research and that of others and is believed to be correct. However, no warranty is expressed or implied. No statement herein extends any license, either expressed or implied, in connection with any patents issued or pending which may be the property of Stepan or others.

SPRAYING: The Stepanfoam BX-350-7 spray system has been evaluated using the Binks Model 43P and Gusmer Airless Spray Guns with excellent results. The mechanical mix air atomization guns which have been used to spray Stepanfoam BX-350-7 are Binks Model 18FM, Decker, Demco and Martin Sweets. The equipment manufacturers' recommendations for hose and block temperatures should be followed. Temperature adjustments should be made to adjust for reactivity and spray pattern.

The substrate to be sprayed shall be free of grease, oil, loose particles, moisture and other foreign matter to assure adequate bonding of foam to metal substrate. Cleaning can be accomplished by commercial sandblasting, wire brush or chemical treatment. To protect substrate and enhance adhesion, a prime coat may be applied to the metal surface.

Foam should not be applied unless the surface temperature is 60°F. or higher. The formation of urethane foam involves an exothermic chemical reaction. Therefore, spraying foam below 60°F. will affect foaming rate, adhesion to substrate and physical properties of the resulting foam.

Exterior surface cannot be sprayed during precipitation periods. No foam should be applied to exterior surface until surfaces are thoroughly dry.

Spraying is not recommended with wind velocities greater than 10-15 miles per hour unless wind barriers are used. High wind velocities result in excessive overspray and fumes which will contaminate adjacent work areas.

STORAGE AND HANDLING: The R Component should be controlled below 75°F. or handled in a totally enclosed, pressurized system to prevent loss of the fluorocarbon blowing agent. The I Component temperature may vary from 65-110°F.

In order to prevent moisture contamination, all containers should be tightly sealed after each use.

Shelf life is six months in sealed containers at room temperature (60-90°F.).

CAUTION: The BX-350-7 foam contains isocyanate and must be used with adequate ventilation. When spraying, air-fed face masks should be worn because of high concentration of isocyanate mist in the atmosphere. Direct contact of the liquid should be avoided. For additional information consult Stepan Chemical Company, Urethane Department, Northfield, Illinois 60093; telephone 312/446-7500.

NOTE: For additional information on the BX-350-7 foam consult the following Stepan Technical Bulletins:

1. Urethane Foam for the Construction Industry
2. Application Specifications Re-Roofing Existing Roof With Urethane Foam Spray Systems

3/75

STEPANFOAM™ BX-250 SERIES

RIGID URETHANE FOAM SYSTEMS

DESCRIPTION: The Stepanfoam BX-250 Series foams are designed as spray systems for use as thermal insulation in panels, cavities and roofing applications. The BX-250 Series foams can be applied to plywood, steel, concrete and other various substrates at temperatures of 60°F. to 100°F. The systems are available in varying reactivities to meet your exact requirements.

PHYSICAL CHARACTERISTICS: The Stepanfoam BX-250 Spray systems are low viscosity systems specifically formulated to offer the maximum compatibility and ease of atomization necessary for spray applications.

BX-250A - Slow version for cool, horizontal surfaces.

BX-250B - Slowest version for horizontal surfaces.

BX-250D - Fastest version for vertical surfaces.

Viscosity @ 73°F.:	R Component	350-400 cps
	T Component	150-200 cps
Specific Gravity:	R Component	1.208
	T Component	1.235
Foam Ratio by Volume:	R Component	50%
	T Component	50%

PHYSICAL PROPERTIES:

Density, pcf	2.1
Compressive Strength, 10% Strain, psi	
Parallel	38
Perpendicular	17
K Factor, Thermal Probe (BTU-in/hr.sq.ft.°F.)	
Initial	0.116
7 days @ 140°F.	0.122
30 days @ 77°F.	0.127
Dimensional Stability, % Volume Change	
1 day @ 200°F.	1.6
1 day @ 110°F. and 100% RH	0.8
7 days @ 158°F. and 100% RH	11.2
14 days @ 158°F. and 100% RH	14.7

The above data should be used as a guide only in the preparation of material specifications since foam properties are dependent upon processing conditions.

All polyurethane foam burns in varying degrees which in turn liberates toxic gases and should be evaluated in its final form on meeting existing standards in your industry.

The information presented herein is based on our own research and that of others and is believed to be correct. However, no warranty is expressed or implied. No statement herein extends any license, either expressed or implied, in connection with any patents issued or pending which may be the property of Stepan or others.

SPRAYING: The Stepanfoam BX-250 spray systems have been evaluated using the Binks Model 43P and Gusmer Airless Spray Guns with excellent results. The mechanical mix-air atomization guns which have been used to spray Stepanfoam BX-250 are Binks Model 18FM, Decker, Demco and Martin Sweets. The equipment manufacturers recommendations for hose and block temperatures should be followed. Temperature adjustments should be made to adjust for reactivity and spray pattern.

The substrate to be sprayed shall be free of grease, oil, loose particles, moisture and other foreign matter to assure adequate bonding of foam to metal substrate. Cleaning can be accomplished by commercial sandblasting, wire brush or chemical treatment. To protect substrate and enhance adhesion, a prime coat may be applied to the metal surface.

Foam should not be applied unless the surface temperature is 60°F. or higher. The formation of urethane foam involves an exothermic chemical reaction. Therefore, spraying foam below 60°F. will affect foaming rate, adhesion to substrate and physical properties of the resulting foam.

Exterior surface cannot be sprayed during precipitation periods. No foam should be applied to exterior surface until surfaces are thoroughly dry.

Spraying is not recommended with wind velocities greater than 10-15 miles per hour unless wind barriers are used. High wind velocities result in excessive overspray and fumes which will contaminate adjacent work areas.

STORAGE AND HANDLING: The R Component should be controlled below 75°F. or handled in a totally enclosed, pressurized system to prevent loss of the fluorocarbon blowing agent. The T Component temperature may vary from 65-110°F.

In order to prevent moisture contamination, all containers should be tightly sealed after each use.

Shelf life is six months in sealed containers at room temperature (60-90°F.).

CAUTION: The BX-250 Series foams contain isocyanate and must be used with adequate ventilation. When spraying, air fed face masks should be worn because of high concentration of isocyanate mist in the atmosphere. Direct contact of the liquid should be avoided. For additional information consult Stepan Chemical Company, Urethane Department, Northfield, Illinois; telephone 312/446-7500.

NOTE: For additional information on the BX-250 Series foams consult the following Stepan Technical Bulletins.

1. Urethane Foam For The Construction Industry
2. Application Specifications Re-Roofing Existing Roofs With Urethane Foam Spray Systems

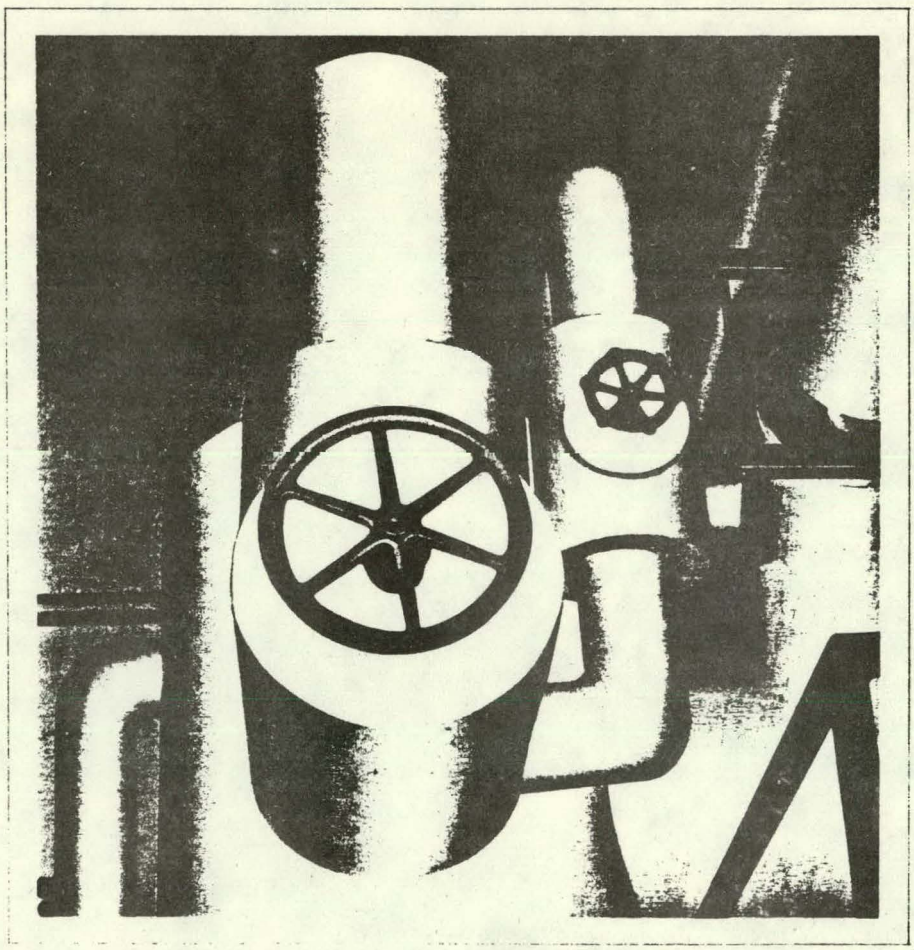
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PIPE INSULATION

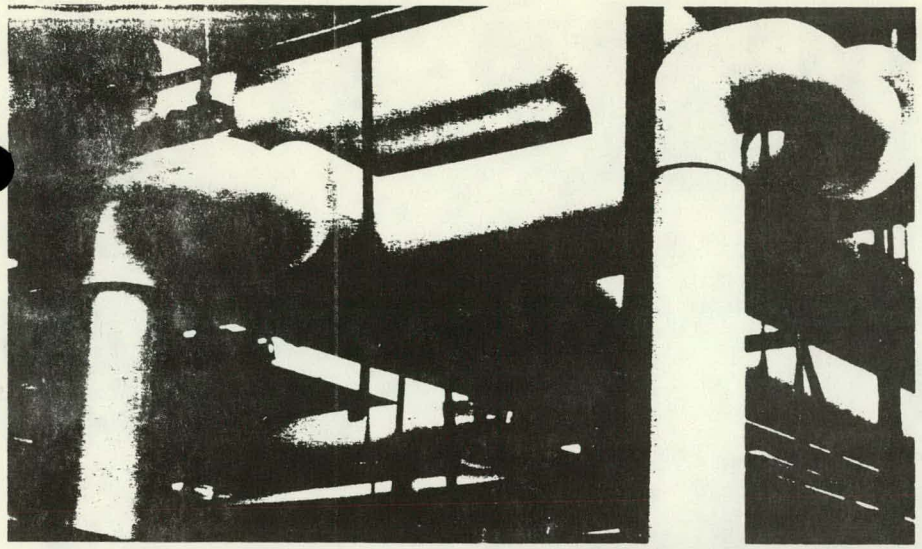
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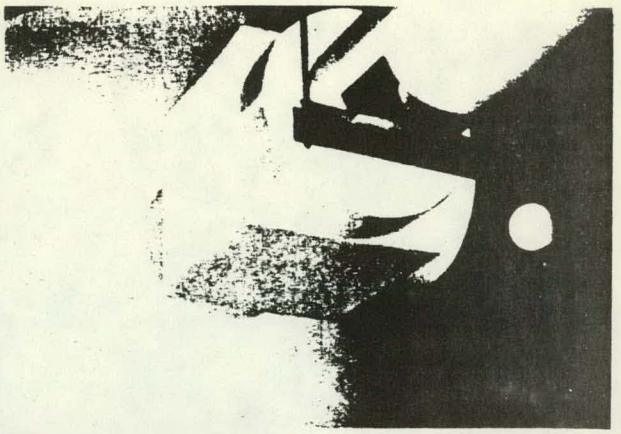
CEL-CO®

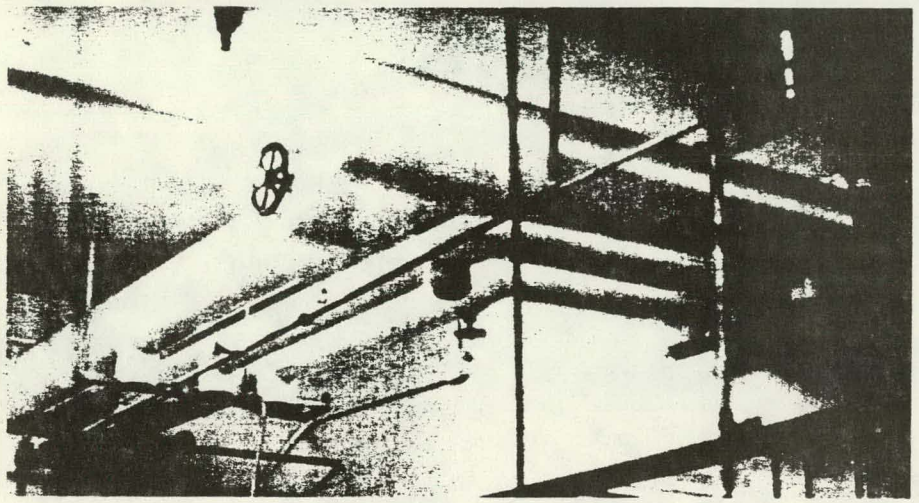
PROTECTIVE JACKETING SYSTEMS AND COVERINGS

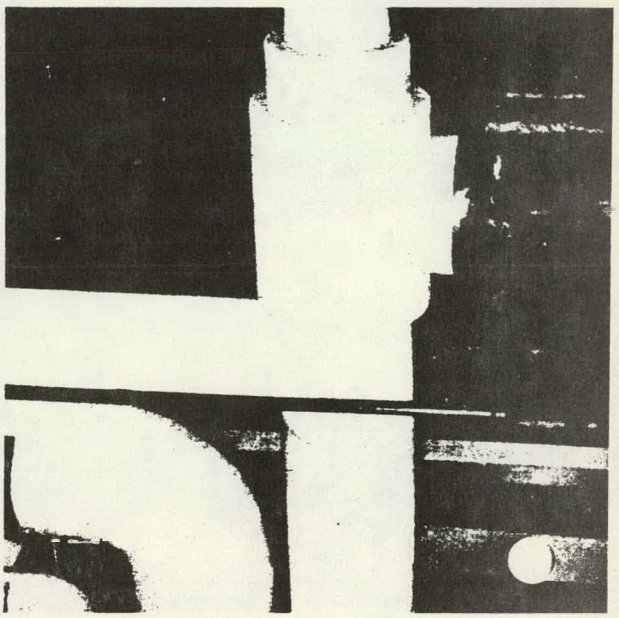


"A SEAL ON THE FUTURE"









CEEL-TITE™ 100 SERIES

Ceel-Tite 130 is an extremely high impact plastic. Characterized by its tough glossy surface, it withstands intermittent temperatures of 180°F and continuous surface temperatures from 160°F to −40°F. Easily cleaned and maintained, and simple to repair in case of rupture, it's an ideal jacketing for complete insulation protection in any food plant, particularly in corrosive atmospheres and wash down areas. It is being used with excellent results by many of the largest food producers in the country.

Ceel-Tite 130 pipe insulation jacketing, together with Ceel-Tite 130 fitting covers, including long radius 90° L's and Ceel-Tite 100 adhesive, plus Ceel-Tite 130 flat stock and 90° angles for flat surfaces and corners, gives complete protection for any piping system, including odd and irregular shapes. (See information and specification sheet for full details.)

CEEL-TITE™ 300 SERIES

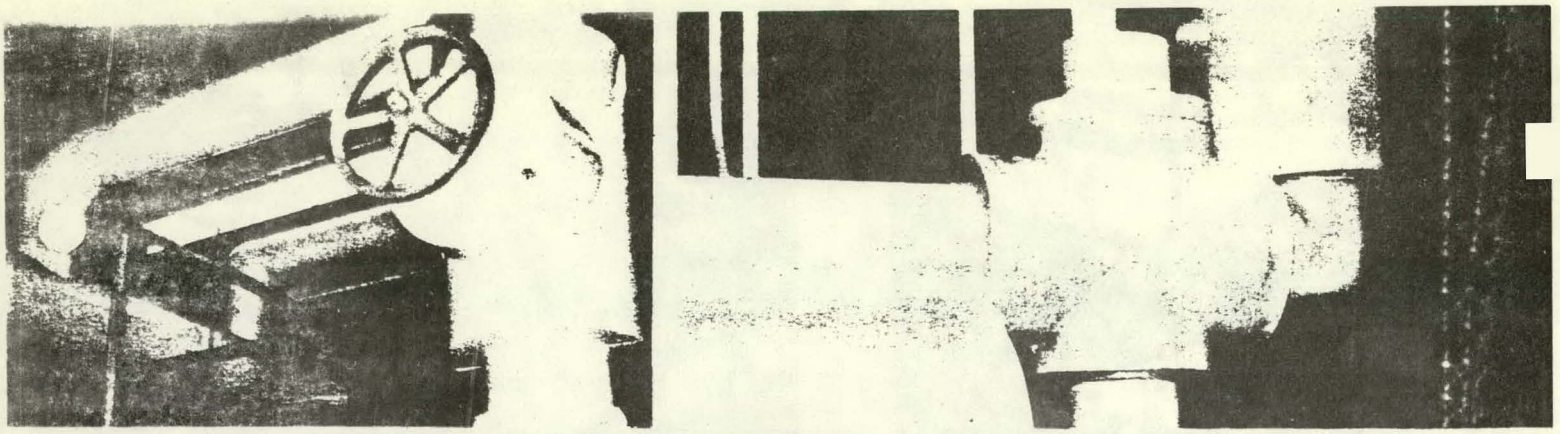
Ceel-Tite 320 and 330 UVR were designed specifically to withstand the weathering and oxidation normally caused by the sun's ultraviolet rays as well as the effects of corrosive and abrasive chemicals: Qualities which make them real money-savers. They are rated self-extinguishing.

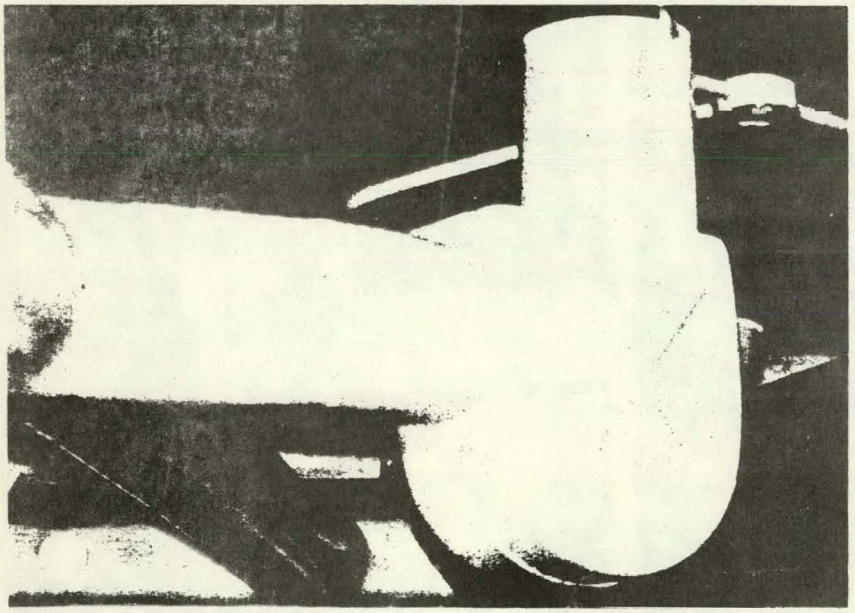
Unusual atmospheric conditions such as exist in refineries, pulp mills, chemical plants and other industries using corrosive and abrasive chemicals cause rapid deterioration of most coverings. Because aluminum generally performs unsatisfactorily under these conditions, and coatings, when used, tend to oxidate, crack and peel, unusual and expensive coverings are often required to protect insulated pipes and surfaces.

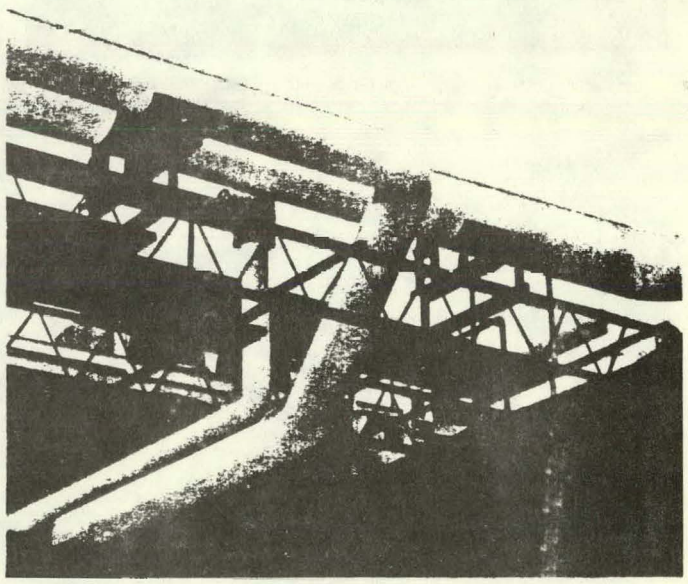
Tough, resilient, high impact plastic, Ceel-Tite 300 series UVR pipe jacketing and coverings perform where other methods fail. Specify Ceel-Tite for positive protection, minimum costs, and years of maintenance free service, in your choice of attractive high gloss white or mat finish.

As with all Ceel-Tite jacketings, they should be sealed with Ceel-Tite's unique welding adhesive, but may be banded or taped if preferred.

All Ceel-Tite jacketing systems are provided with a minimum one inch overlap for complete protection. Ceel-Tite 300 is a superior jacketing that is realistically priced, easy to install, and will provide years of maintenance free service, outdoor, indoor, or both. (See information sheet for complete details.)







CEEL-TITE™ 400 SERIES

A liquid plastic coating, Ceel-Tite 423 is formulated from the same resin as the Ceel-Tite 100 Series. Extremely tough and impervious to most contaminants that destroy other coatings, 423 is solvent based, and it may be brushed, rolled or thinned for spraying.

Ceel-Tite 410 and 415 water based primer and sealer are for use on rough or smooth surfaces, respectively, as a base for Ceel-Tite 423. Not for use as a finish coat. (See information and specification sheet for full details.)

CEEL-TITE™ 500 SERIES (Pan'l-in)

The Ceel-Tite 500 Series includes all insulated panels of any material thickness and combination of surfaces, both front and back. Available in glossy, mat or textured finish. Ceiling panels are available in sizes ranging from 2′ x 4′ to 4′ x 8′. Standard wall panels are 4′ x 8′, with special sizes furnished on request. Accessory items necessary for a complete job, such as divider bars, T-bars, corner angles, etc., are available. (See information and specification sheet for full details.)

CEEL-TITE™ 600 SERIES (Special Shapes and Flat Stock)

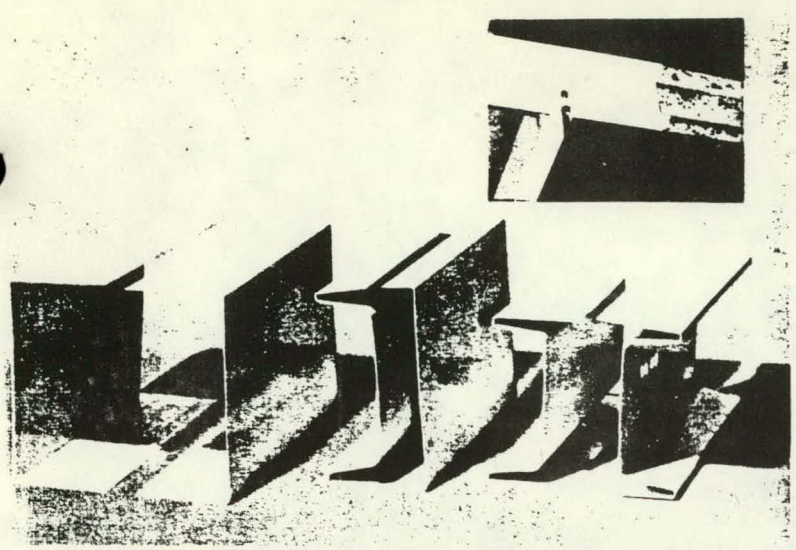
The Ceel-Tite 600 Series includes protective coverings for *I-beams, box, *C-channels, walls, ceilings, hanger rods, uninsulated pipe, sprinkler system piping, electrical conduits, and most structural members where paint failure and metal corrosion is a continuous problem. The ultimate in performance is the Ceel-Tite system. (See information and specification sheet for full details.)

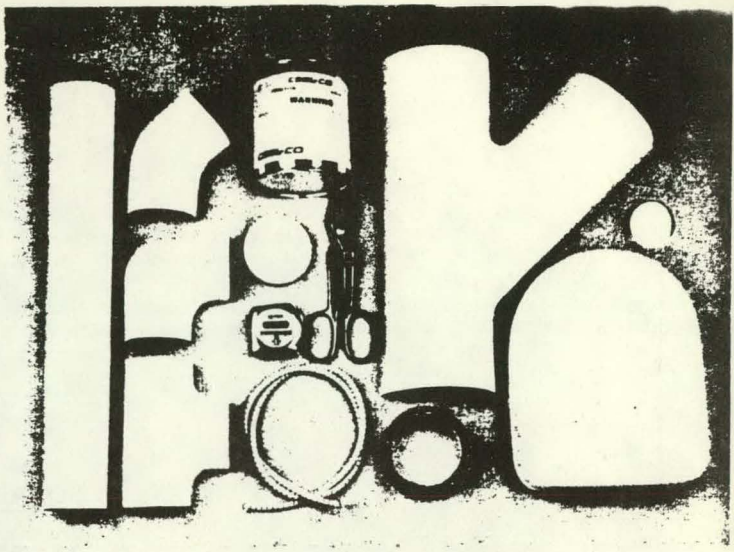
THE CEEL-TITE™ SYSTEM

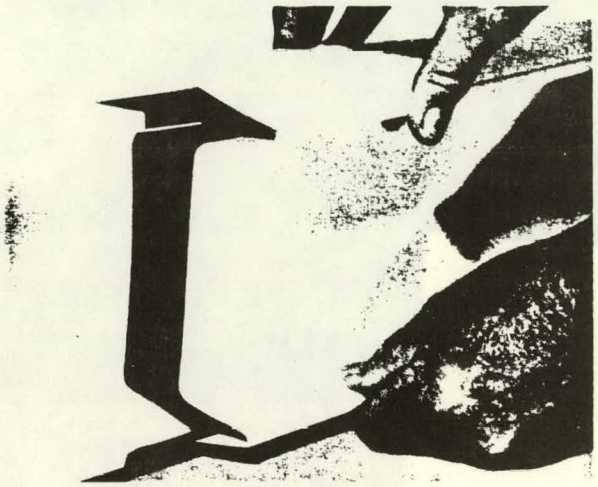
Every plant can use a Ceel-Tite™ protective jacketing and covering system. Indoor, outdoor or both. The Ceel-Tite™ system consists of rugged plastic insulation jacketings... fitting covers... *I-beam and *C-channel covers ...rod hanger covers... conduit and wall covers... insulated panels and coatings. For positive protection, Ceel-Tite™ it.

The Ceel-Tite™ system is designed to meet the stringent requirements demanded by U.S.D.A. and F.D.A. regulations. In meeting those requirements demanded by law and consumers alike, all working areas in food or beverage producing facilities must be completely free of contaminants.

Ceel-Tite™ products, properly installed, give complete protection against bacterial growth, dirt accumulation and possible penetration, as well as the









Ceel-Tite System Cont'd.

destructive effects of corrosive atmospheres. The unique welding adhesive used in the Ceel-Tite™ system assures that all joints required, are positively and permanently sealed. Provisions for expansion may and should be made when required.

The same excellent Ceel-Tite™ performance has proven equally successful in the petro-chemicals field, power and most commercial and industrial applications, including underground. Available in a wide variety of weights and thicknesses, the Ceel-Tite™ system is the answer to the problem of attaining effective dependable insulated pipe and surface protection.

THE CEEL-TITE™ SYSTEM FEATURES

A type, size, and shape to fit your needs • Protects against mold, fungus, corrosion, moisture, and many unusual acid or alkaline conditions • Eliminates the need for stainless in many applications and at a much lower cost. • Easily kept clean and bright even under normal daily washdown conditions • Tough...no chipping, cracking, denting or peeling • Eliminates painting...minimum maintenance • Use anywhere...indoor, outdoor, or underground. • Meets U.S.D.A. regulations...non-toxic • Save on expensive job-site fabrication costs with ready to use preformed materials • That's why we say... For positive protection, Ceel-Tite™ it!

CEEL-TITE™ *Product Information Sheets

Ceel-Tite 100 Series (Jacketing) 1/876

Ceel-Tite 300 Series UVR (Jacketing) 5/876

Ceel-Tite 400 Series (Coatings) 7/876

Ceel-Tite 500 Series (Pan'l-in) 9/476

Ceel-Tite 600 Series (Specialties) 11/876

Ceel-Tite Jacketing Methods 12/876

Thickness Tables 5-1-76

*Available upon request.

CEEL-CO®

"A Seal on the Future"

260 YUMA, DENVER, COLORADO 80223 / PHONE (303) 722-4535 OR (303) 722-1231

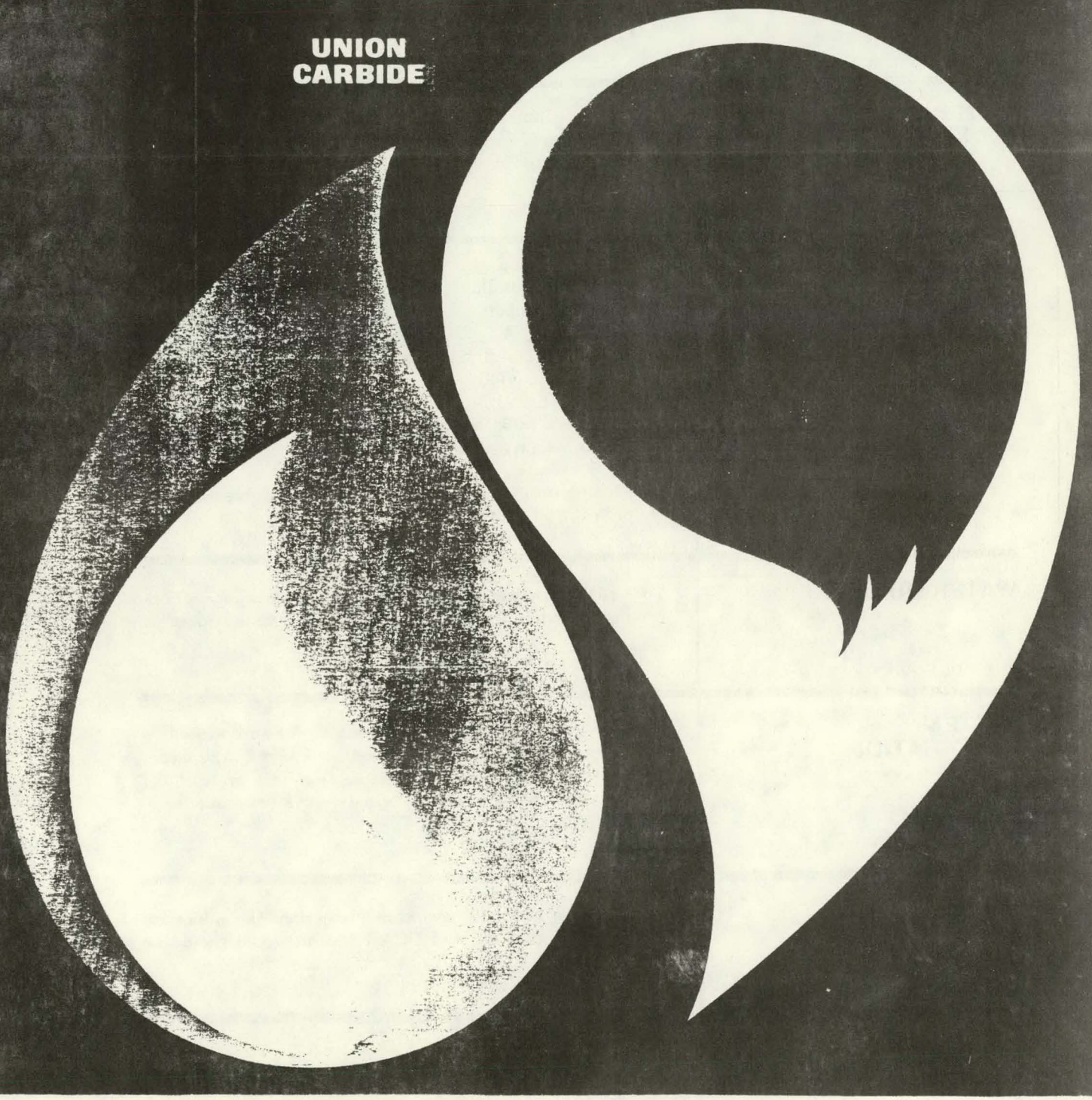
SOLAR FLUID

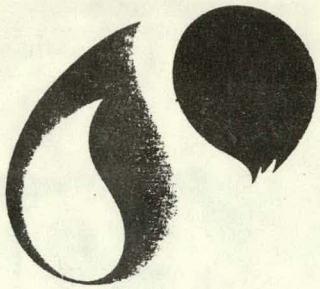
(ANTIFREEZE)

UCAR® FOODFREEZE 35

A PROPYLENE GLYCOL-BASED INDUSTRIAL COOLANT AND HEAT TRANSFER FLUID

UNION CARBIDE





Operating Practices — UCAR® Foodfreeze 35

MATERIALS OF CONSTRUCTION	• Steel, aluminum, polyethylene, and other common elastomers. Not recommended for use with copper, brass, or galvanized steel.
OPERATING TEMPERATURES	• Minimum bulk fluid temperature . . . −33°C. (at lower temperatures viscosity is a major factor) • Maximum bulk fluid temperature, with a high degree of aeration . . . 80°C. • Maximum bulk fluid temperature, with vent or breather line as a source of air . . . 150°C. • Maximum skin temperature on UCAR Foodfreeze 35 side of heat exchanger . . . 160°C.
WATER QUALITY	• Use distilled water, deionized water, or soft water containing less than 100 ppm of chloride and/or sulfate ions.
SYSTEM PREPARATION	Before installing UCAR Foodfreeze 35, be sure system is free from scale, rust, sediment, and residual chlorides if converted from brine systems. The services of a professional cleaner may be required to prepare the system properly.
MINIMUM CONCENTRATION	To provide adequate corrosion protection, the minimum aqueous concentration of UCAR Foodfreeze 35 should be 20 per cent.

Table 1 – Typical Physical Properties – UCAR® Foodfreeze 35

Determined on typical commercial material

Specific Gravity at 20/20°C.	1.050 to 1.054
Boiling Point at 760 mm. Hg	162.0°C.
at 50 mm. Hg	88.5°C.
at 10 mm. Hg	58.2°C.
Vapor Pressure at 20°C.	0.66 mm. Hg
Freezing Point	−51°C.
Freezing Point of 50% Aqueous Solution	−27°C.
Viscosity at 0°C.	265.8 centipoises
at 20°C.	63.6 centipoises
at 40°C.	26.5 centipoises
Refractive Index, n_D20°C.	1.43042
Specific Heat at 20°C.	0.605 cal./(g.)(°C.) 0.605 Btu./(lb.)(°F.)
Thermal Conductivity at 20°C.	0.00050 cal./(sec.)(cm.²)(°C./cm.) 0.12 Btu./(hr.)(ft.²)(°F./ft.)
Flash Point	
Concentrate:	
Pensky-Martens closed cup (ASTM method D 93)	99°C. (210°F.)
Cleveland open cup (ASTM method D 92)	116°C. (240°F.)
Aqueous solutions:	
Pensky-Martens closed cup (ASTM method D 93)	No flash point
Cleveland open cup (ASTM method D 92)	No flash point
Aqueous solutions (<90%)	No flash point

Table 2 – Specifications – UCAR® Foodfreeze 35

Subject to change without notice

Specific Gravity at 20/20°C.	1.050 to 1.054
pH at 25°C. of 30% aqueous solution	8.0 to 10.0
Color	Clear (10 Pt-Co. max.)
Suspended Matter	Substantially free from dirt, lint, and foreign particles. A slight haze is permissible.
Inhibitor Package	2% by wt.

Table 3 – Typical Physical Properties for Aqueous Solutions of UCAR® Foodfreeze 35

FREEZING POINTS/BOILING POINTS/SPECIFIC GRAVITIES/REFRACTIVE INDICES

Per Cent by Volume	Per Cent by Weight	Freezing Point, °F.	Boiling Point, °F.	Specific Gravity, 60/60°F.	Specific Gravity, 40/60°F.	Refractive Index, n_D 77°F.	Degrees Brix[b]
20	20.6	20	214	1.021	1.026	1.3550	14.75
21	21.6	19		1.022	1.027	1.3561	15.50
22	22.6	18		1.023	1.028	1.3572	16.00
23	23.6	17		1.024	1.029	1.3583	16.75
24	24.5	16	215	1.025	1.031	1.3594	17.50
25	25.5	15		1.026	1.032	1.3605	18.25
26	26.5	14		1.027	1.033	1.3616	18.75
27	27.4	13		1.028	1.034	1.3627	19.50
28	28.4	12		1.029	1.035	1.3638	20.25
29	29.4	11	216	1.029	1.037	1.3649	21.00
30	30.3	9		1.030	1.038	1.3660	21.50
31	31.3	8		1.031	1.039	1.3671	22.25
32	32.3	7		1.032	1.040	1.3682	22.75
33	33.3	5		1.033	1.041	1.3693	23.50
34	34.3	4	217	1.034	1.042	1.3703	24.00
35	35.3	2		1.035	1.044	1.3714	24.75
36	36.2	1		1.036	1.045	1.3725	25.50
37	37.2	− 1		1.037	1.046	1.3736	26.00
38	38.2	− 3	218	1.038	1.047	1.3747	26.50
39	39.2	− 4		1.039	1.048	1.3758	27.25
40	40.2	− 6		1.040	1.049	1.3768	27.75
41	41.2	− 8	219	1.040	1.050	1.3779	28.25
42	42.2	−10		1.041	1.050	1.3790	29.00
43	43.2	−12		1.042	1.051	1.3800	29.50
44	44.1	−14	220	1.043	1.052	1.3811	30.25
45	45.1	−16		1.044	1.053	1.3821	30.75
46	46.1	−18		1.045	1.054	1.3832	31.25
47	47.1	−20	221	1.046	1.054	1.3842	32.00
48	48.0	−22		1.047	1.055	1.3853	32.50
49	49.0	−25		1.047	1.056	1.3863	33.00
50	50.0	−27	222	1.048	1.057	1.3874	33.50
51	51.0	−29		1.049	1.057	1.3884	34.25
52	52.0	−32	223	1.049	1.058	1.3895	34.75
53	53.0	−34		1.050	1.058	1.3905	35.25
54	54.0	−36	224	1.051	1.059	1.3916	35.75
55	55.0	−39		1.051	1.060	1.3926	36.25
56	56.0	−41	225	1.052	1.060	1.3937	36.75
57	57.0	−44		1.052	1.061	1.3947	37.50
58	58.0	−47	226	1.053	1.061	1.3957	38.00
59	59.0	−50		1.053	1.062	1.3967	38.50
60	60.0	−53	227	1.054	1.062	1.3977	39.00
61	61.0	(a)		1.054	1.063	1.3986	39.50
62	62.1	(a)	228	1.055	1.063	1.3995	40.00
63	63.1	(a)		1.055	1.063	1.4004	40.50
64	64.1	(a)	229	1.055	1.064	1.4013	40.75
65	65.1	(a)	230	1.056	1.064	1.4022	40.25

(a) Solution near its freezing point is extremely viscous, and hence, a true value is not easily determined.

(b) Values determined to nearest 0.25 to facilitate readings with the American Optical Refractometer, Model 10431.

$125.00

155

How to Maintain the Performance of Aqueous Solutions of UCAR® Foodfreeze 35

Table 6 – Properties/Limits

Aqueous Solutions of UCAR Foodfreeze 35	Property	Limits	Test Method
	Appearance	Relatively clear, water-white liquid, low sediment content	A
	pH	8.0 to 9.6	B
	Phosphate Ion Content	2,000 ppm, minimum	C
	Chloride Ion Content	Less than 100 ppm	D
	Freezing Protection	Allow 5°F. safety factor	E

Test Methods for Measuring the Properties of UCAR® Foodfreeze 35 Solutions

A/APPEARANCE

Pour representative sample system solution into a suitable, clean, clear, glass flask. Shake the flask and examine visually. A hazy solution may be an indication of the presence of corrosion products or other contamination.

B/pH

The pH of the sample system solution is best determined by means of a suitable pH meter employing a calomel-glass electrode combination. If circumstances make use of a pH meter impractical, other suitable means such as a pH slide comparator or appropriate "pHydrion" test papers which change color over a narrow pH range can be employed.

C/PHOSPHATE ION CONTENT

This method is based on a test kit available from the Taylor Instrument Company, Baltimore, Maryland. Similar apparatus from other suppliers should also be suitable.

EQUIPMENT AND REAGENTS

1. Base for 5 mil. round test tubes; Catalog No. 531.
2. High phosphate comparator slide, 5 to

(continued)



100 ppm.; Catalog No. 1100.
3. Reagent vial with 0.5 ml. pipet (2); Catalog No. 502A.
4. High phosphate mixing tube (4); Catalog No. 515.
5. Test tubes, 5 mil. capacity (6); Catalog No. 500.
6. Molybdate reagent for phosphate determination, 32 oz.; Catalog No. 601.
7. Stannous chloride reagent for phosphate determination, 4 oz.; Catalog No. 602.

NOTE: Numbers in parentheses are suggested quantities to keep on hand.

SAMPLE PREPARATION

UCAR Foodfreeze 35 contains phosphate ion. To use the specified equipment to test the solution, an appropriate dilution of the sample system solution should be made to facilitate evaluation on the high phosphate comparator slide (5 to 100 ppm.). For example, if the sample solution is diluted 1:100 (use an appropriate pipet and volumetric flask) and the phosphate ion content of this diluted sample is shown by the slide to be 30 ppm., then simply multiplying 30 by the dilution factor of 100 will give 3,000 ppm. as the phosphate ion content of the original sample system solution.

TEST PROCEDURE

Add the diluted sample system solution to the first line on the high phosphate mixing tube; the addition is equal to 5 ml. Next add molybdate reagent (as supplied) to the second line on the tube; addition is equal to 10 ml. Stopper the tube and shake. Now add 2.5 ml. of the stannous chloride solution prepared by following the simple directions on the reagent vial, using the marked eye dropper. Stopper and shake. A blue color should develop if phosphate is present.

Transfer this blue colored solution to a 5 ml. test tube, and place it in the center hole on the base. Place two, 5 ml. test tubes of water on both sides of this test solution. Place the 5 to 100 ppm. phosphate slide comparator on the base and compare the various color intensities. Select the one best matching the intensity of the blue colored sample solution. This value, when multiplied by the dilution factor, should give the phosphate ion content of the original system solution.

ADJUSTING OF SYSTEM SOLUTION

When an adjustment is necessary, the addition should be based upon the fact that adding 1.5 pounds of dipotassium hydrogen phosphate (K_2HPO_4) to each 100 gallons of system solution is equivalent to adding approximately 1,000 ppm. of phosphate ion.

A good grade phosphate salt, low in chloride and sulfate ion content, should be employed and be predissolved in either water or a portion of the glycol coolant apart from the system.

D/CHLORIDE ION CONTENT

The necessity of determining the chloride ion content is usually governed by its content in the water employed for dilution. Actually, the use of distilled or deionized water is suggested unless the overall hardness of the proposed water is known to be low. Details for the procedure are available on request.

E/FREEZING PROTECTION

To determine the freezing protection safety factor, use the appropriate physical property information given in Table 3 for aqueous solutions of UCAR Foodfreeze 35. Freezing points/UCAR Foodfreeze 35 concentrations are best determined by refractive index. An inexpensive, hand-held refractometer, Model 10431, is available through American Optical Corp., Scientific Instrument Division, Buffalo, New York 14215. Reliance on specific gravity should be approached with caution due to the relatively small change in reading which occurs with increase in UCAR Foodfreeze 35 concentration, especially in the upper concentration region. It should be noted that the specific gravity versus composition curve passes through a maximum at about 75 per cent UCAR Foodfreeze 35. Because of this phenomenon, double check specific gravity readings for solutions containing above 50 per cent UCAR Foodfreeze 35 by an appropriate water dilution which can then be extrapolated back to the original.

FLOOD ALARM

OR IMPLIED, AND THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXCLUDED BEYOND THE ONE (1) YEAR DURATION OF THIS WARRANTY.

If the detector is defective, package it carefully, along with proof of purchase (including the date of purchase) and a short description of the malfunctions, and mail it, postage prepaid, to the following address:

Datasonic Inc.
150 West Pine Street
Long Beach, New York 11561

NEW ADDRESS
DATASONIC, INC.
255 EAST SECOND STREET
MINEOLA, NEW YORK 11501

FLOOD ALERT™
Water Sensing Alarm

OPERATING INSTRUCTIONS

1. Open case by inserting screwdriver in slots on bottom of the case. Gradually pry each end up until the case separates.
2. Install a fresh 9 volt alkaline battery.
3. Close case by pushing the bottom evenly into the top.
4. Before installing, test FLOOD ALERT by touching both "water sensors" to a wet sponge or cloth. A loud, high-pitched beeping sound will be heard.
5. Place FLOOD ALERT in desired location. BE SURE BOTH "WATER SENSORS" ARE TOUCHING THE SURFACE WHERE WATER IS TO BE DETECTED.

NOTES

- Do not totally immerse FLOOD ALERT in water. It will not function.
- FLOOD ALERT will activate when water contacts the "water sensors". Alarm will cease and reset automatically when dry.
- Every few months, test FLOOD ALERT by touching both "water sensors" to a wet sponge or cloth.
- Replace battery yearly or after FLOOD ALERT's alarm has sounded continually for more than 24 hours.

LIMITED WARRANTY

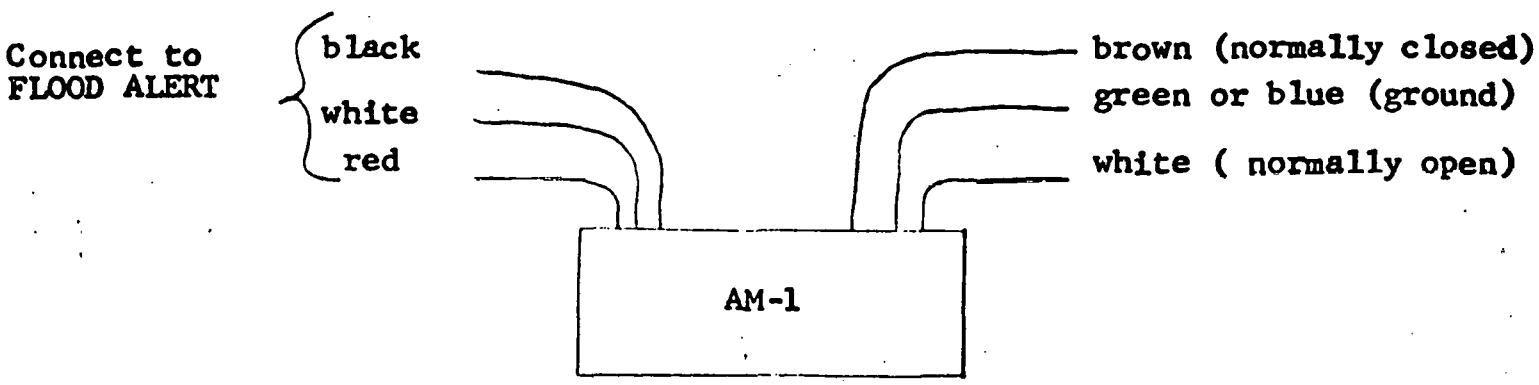
Datasonic, Inc. warrants to the consumer that its FLOOD ALERT water detector will be free from defects in workmanship or materials, under normal use and service, for a period of one (1) year from the date of original purchase by a consumer. If, at any time during the warranty period, the detector is defective or malfunctions, Datasonic shall replace it within a reasonable period of time by shipping a replacement unit to the consumer postage prepaid. This warranty shall not apply if it is shown by Datasonic that the defect or malfunction was caused by damage which occured while the detector was in the possession of a consumer. Datasonic's sole responsibility shall be to replace the detector within the terms stated above.

DATASONIC SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF ANY WARRANTY, EXPRESS OR IMPLIED, APPLICABLE TO THIS PRODUCT. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS

Datasonic Inc.
150 West Pine Street, Long Beach, New York 11561 — (516) 889-4078

INSTRUCTIONS FOR AM-1 - (AUXILIARY OUTPUT MODULE)

1. Remove two metal eyelets which hold circuit board to case.
2. Remove circuit board.
3. Drill approximately 3/16" hole on side of case top.
4. Insert black, white and red wires from AM-1 through hole in case.
5. Solder black wire to hole marked GRD.
6. Solder white wire to hole marked AUX.
7. Solder red wire to red battery lead wire.
8. Insert 47K ohm resistor as shown on diagram. NOTES- Some circuit boards will already have this part installed.
9. Place circuit board back into case base.
10. Use pliers or vise to re-install two metal eyelets (supplied).
11. To have unit emit a steady tone or pulse only once, remove .22 MFD capacitor from circuit board.
12. Close case and test for proper functioning.



MICRO COMPUTER

System Two Disk Computer (cont'd)

TECHNICAL SPECIFICATIONS
System Two Disk Computer System

Processor: 4 MHz version Z-80
Cycle time: 250 nanoseconds
Minimum instruction execution time: 1 microsecond
Instruction set: 158 instructions including the 78 instructions of the 8080
System bus: Industry standard S-100
Board capacity: 21 boards
Disk drive capacity: 2 drives (supplied)
Disk storage capacity: 184K bytes each disk
RAM memory: 64K bytes
Printer interface: Supports Cromemco dot-matrix or fully-formed-character printers
PROM firmware: 1K bytes (2708 PROM)
Serial interface: RS-232 or current loop; 110 to 76,800 baud. Supports Cromemco CRT terminal.
Parallel interface: 8 bit TTL levels
Power supply: +8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A
Power: Operates from 110/220 volts; 50/60 cycle
Operating environment: 0-55°C
Dimensions: 12¼"H x 19"W x 20¾"D (31.1 x 48.3 x 52.7 cm)
Weight: 49 lbs (22 kg)
Mounting: For rack mounting (optional cabinets available)

Z-2 Computer System

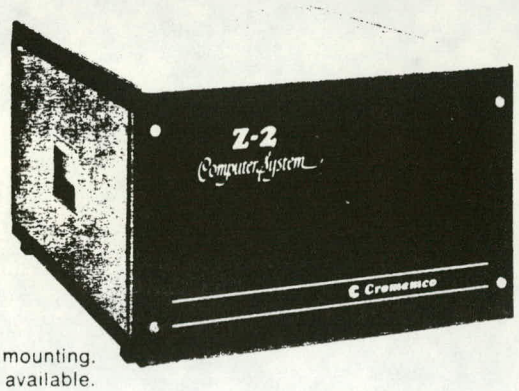
Z-2 COMPUTER SYSTEM

The Model Z-2 is a building-block computer. It includes the popular Cromemco ZPU processor card and a heavy-duty power supply, all housed in a rugged metal rack-mount cabinet.

The computer further includes spaces for 21 circuit boards so that you can install memory, I/O, or custom circuits as your needs require.

PRICE

Model Z-2W Computer; fully assembled . . . . . $995.



Z-2 is supplied for rack mounting.
Attractive bench cabinet shown is also available.

TECHNICAL SPECIFICATIONS
Z-2 COMPUTER SYSTEM

Processor: 4 MHz version Z-80
Cycle time: 250 nanoseconds
Minimum instruction execution time: 1 microsecond
Instruction set: 158 instructions including the 78 instructions of the 8080
System bus: industry standard S-100
Board capacity: 21 boards
Power: Operates from 110/220 volts; 50/60 cycles.
Power supply: +8 volts @ 30A, +18 volts @ 15A, −18 volts @ 15A
Operating environment: 0-55°C
Dimensions: 12¼" H x 19" W x 20¾" D (31.1 x 48.3 x 52.7 cm)
Weight: 39 lbs (18 kg)
Mounting: For rack mounting (optional bench cabinet available)

U.P.S.

(Uninteruptable Power Supply)

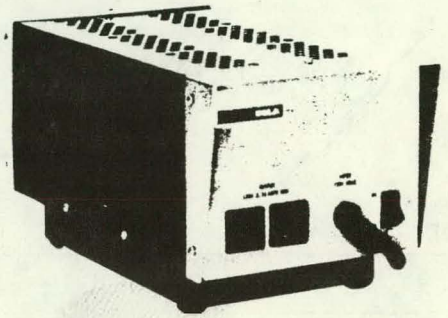
Sola Minicomputer Regulators

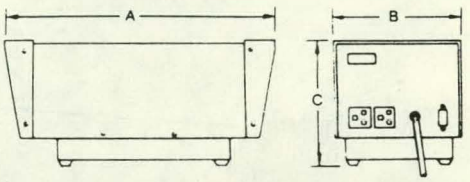
The Sola Mirco/Mini Computer Ultra Isolated Regulator provides instantaneous voltage regulation, and ultra isolation from both transverse and common mode noise for any type of load. It also suppresses transients, protects against overloads and serves as a portable dedicated line. It is the ultimate in AC line conditioning equipment.

The Sola "Micro/Mini" is particularly applicable in systems involving mini or micro computers, POS equipment, micro-processors, or data terminals — where noise and transients cause errors, or low voltage and short term disruptions can result in loss of memory. The output waveshape is sinusoidal and contains less than 3% harmonic distortion, making it ideal for any electronic load.

Common mode noise rejection exceeds 120 db for the regulator, while transverse noise rejection is better than 60 db — true ultra-isolation. Brownout protection is a real bonus feature. Input line voltage variations as great as ± 15% are instantaneously regulated to a maximum output deviation of ± 3%. And, the output will remain within NEMA voltage specifications for input voltages as low as 65% of nominal.

The portable 140 to 2000VA models are designed for office type environments and have a low sound level of 43 db.





NOTE: 2000 VA MODELS HAVE 30 AMP TWIST RECEPTICLE.

U.L. LISTED

Portable Models

60 Hertz Single Phase

Maximum Output VA Rating	Nominal Output Voltage	Input† Voltage Range	Catalog Number	Approx. Shipping Weight	Dimensions		
					A	B	C
140	120	95-130	**63-13-114**	18	14.00	6.00	5.56
250	120	95-130	**63-13-125**	31	15.60	8.12	7.31
500	120	95-130	**63-13-150**	47	18.60	8.92	8.68
750	120	95-130	**63-13-175**	60	18.60	8.92	8.68
1000	120	95-130	**63-13-210**	75	18.60	8.92	8.68
2000	120	95-130	**63-13-220**	125	18.84	11.38	10.62

†For ± 3% output regulation. Unit will operate at lower voltage.

50 Hertz Single Phase††

Maximum Output VA Rating	Nominal Output Voltage	Input† Voltage Range	Catalog Number	Approx. Shipping Weight	Dimensions		
					A	B	C
140	220	180-260	**63-13-614**	22	15.60	8.12	7.31
250	220	180-260	**63-13-625**	35	15.60	8.12	7.31
500	220	180-260	**63-13-650**	53	18.60	8.92	8.68
1000	220	180-260	**63-13-710**	85	18.60	8.92	8.68
2000	220	180-260	**63-13-720**	140	18.84	11.38	10.62

††50 Hertz units not U.L. Listed.

FIG. 1

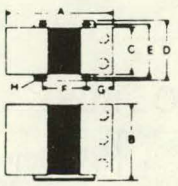


FIG. 2

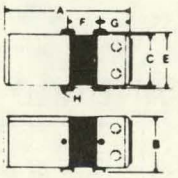
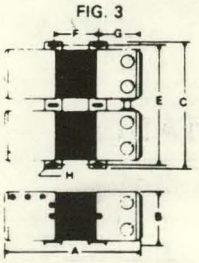


FIG. 3

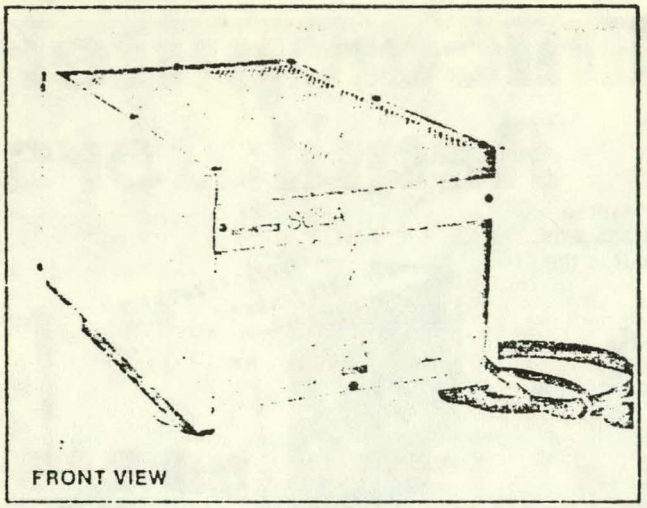


U.L. LISTED

Hard-Wired Models

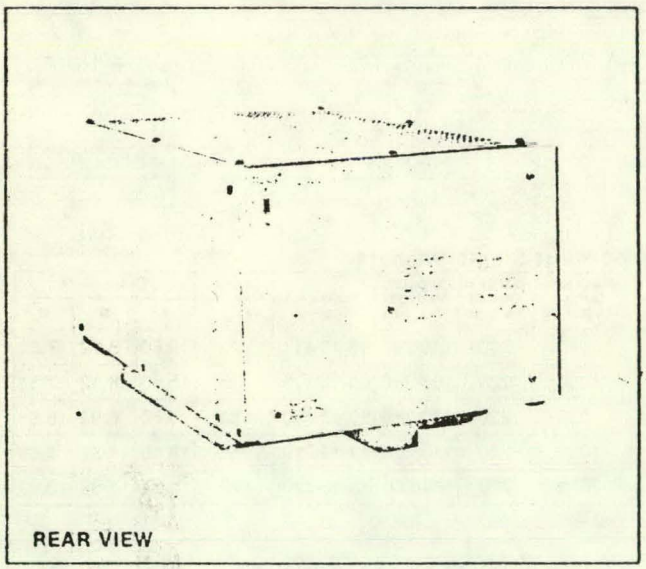
60 Hertz Single Phase (Hard-wired)

Voltage Rating		VA	Catalog Number	App Ship Wt (Lbs.)	Fig No.	Dimensions (Inches)							
Regulated Output	Input Range					A	B	C	D	E	F	G	H
120	175-235x190-260 x380-520	120	63-23-112	14	1	7 1/16	5 1/16	3 5/16	4	3 1/2	3	2 1/16	1/32 x 1/32
		250	63-23-125	28	1	9 1/8	7 1/16	4 1/2	5 1/8	4 1/4	4 1/8	2 1/16	1/16 x 1/16
		500	63-23-150	40	1	15 1/8	6 1/16	7 1/2	9	8 1/8	5 1/8	3 1/16	1/8 x 1/16
		750	63-23-175	54	1	16 1/16	6 1/16	7 1/2	9	8 1/8	5 1/8	3 1/16	1/8 x 1/16
		1000	63-23-210	68	1	17 1/8	6 1/16	7 1/2	9	8 1/8	5 1/8	4 1/16	1/8 x 1/16
		1500	63-23-215	105	2	19 1/2	9 1/2	10 1/16		11 1/4	3 1/2	5 1/16	1/16 x 1/16
		2000	63-23-220	140	2	19 1/16	9 1/2	10 1/16		11 1/4	4 1/8	5 1/16	1/16 x 1/16
120x240	95-130x175-235 x190-260	3000	63-25-230-3	194	2	21 1/8	9 1/2	10 1/16		11 1/4	6 1/16	5 1/16	1/16 x 1/16
	190-260x380-520	3000	63-26-230	196	2	21 1/8	9 1/2	10 1/16		11 1/4	6 1/16	5 1/16	1/16 x 1/16
	95-130x175-235 x190-260	5000	63-25-250	335	3	20 1/16	9 1/2	22 1/2		24 13/16	5 1/16	5 1/16	1/16 x 1/16
	190-260x380-520	5000	63-26-250	342	3	20 1/16	9 1/2	22 1/2		24 1/16	5 1/16	5 1/16	1/16 x 1/16
		7500	63-28-275	502	1	20 1/16	9 1/8	35 1/2		37 1/2	5 1/16	5 1/16	1/16 x 1/16



FRONT VIEW

FIGURE 1



REAR VIEW

1.0 INTRODUCTION

1.1 Sola Electric Mini Uninterruptible Power Supply (UPS) systems provide continuous, regulated noise-free AC power to critical load applications. These are totally integrated units containing rectifier/battery charger, battery and inverter. The rectifier converts the input AC line to DC, maintaining the battery fully charged and simultaneously providing DC power to the inverter. The battery continues to power the inverter when the input AC line fails. The inverter converts DC power to regulated sine wave AC output.

1.2 The Mini UPS systems are of the on-line type, with the inverter supplying AC power to the critical load at all times. Figure 1 shows a typical Mini UPS system.

TABLE 1 — STANDARD MODELS

Catalog Number	Output Power (At 0.8 Pf)	Input/ Output Frequency	Input/ Output Voltage	Battery* Back-Up Time	Approx. Weight
26-00-50400-3X00	400 VA	60 Hz	120 VAC	10 minutes	85 lbs.
26-00-50400-3X01	400 VA	60 Hz	120 VAC	20 minutes	100 lbs.
26-00-50750-3X00	750 VA	60 Hz	120 VAC	10 minutes	120 lbs.
26-14-50300-3X00	300 VA	50 Hz	220 VAC	12 minutes	100 lbs.
26-16-50300-3X00	300 VA	50 Hz	240 VAC	12 minutes	100 lbs.
26-14-50300-3X01	300 VA	50 Hz	220 VAC	24 minutes	115 lbs.
26-16-50300-3X01	300 VA	50 Hz	240 VAC	24 minutes	115 lbs.
26-14-50600-3X00	600 VA	50 Hz	220 VAC	12 minutes	135 lbs.
26-16-50600-3X00	600 VA	50 Hz	240 VAC	12 minutes	135 lbs.

* X is 0 for standard units and X is 1 for units with battery supplying power annunciation.

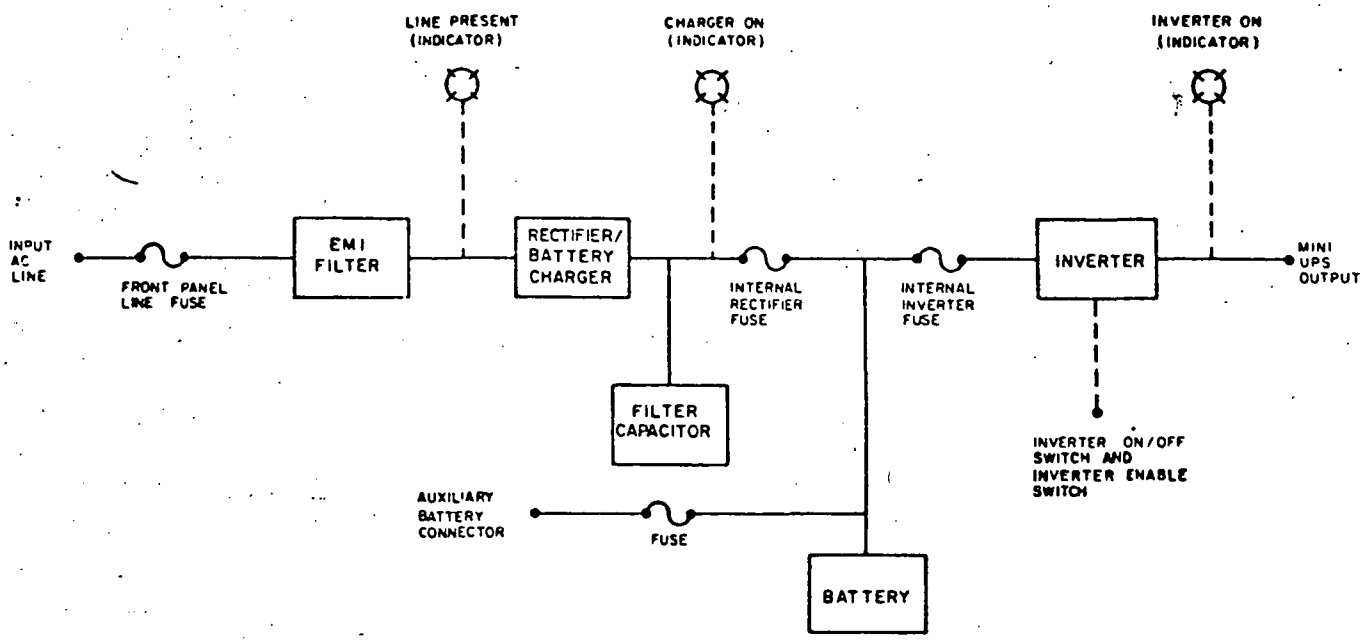


FIGURE 2—TYPICAL MINI UPS SYSTEM ILLUSTRATION

5.0 GENERAL DESCRIPTION

5.1 A description of the Mini UPS systems and a brief discussion on the operation is presented. This should be read before initial startup – so as to assist in verifying proper operation or detecting possible defects.

5.2 **Controls** – The Mini UPS has only two (2) control switches, labelled INVERTER ON/OFF and INVERTER ENABLE. The INVERTER ENABLE switch is located on the rear panel and is screwdriver operated – this is provided as a safety feature to prevent the inverter from being accidentally turned on. The INVERTER ON/OFF switch is located on the front panel and controls inverter operation. Note that the rectifier cannot be switched on or off; it operates whenever the input line cord is plugged into a mating source and the AC line is present.

5.3 **Indicators** – The Mini UPS has three (3) lamps on the front panel, labelled LINE PRESENT, CHARGER ON and INVERTER ON. The LINE PRESENT and CHARGER ON lamps should always illuminate together unless a fault exists in the rectifier/charger. The INVERTER ON lamp illuminates when AC voltage is present at the inverter output.

5.4 **Fuses** – An AC LINE FUSE is provided on the front panel to protect the rectifier. The output of the rectifier and input to the inverter are also fused, but these are not user replaceable.

7.0 INITIAL TURN ON

7.1 The purpose of this procedure is to familiarize the user with the Mini UPS controls and indicators, as well as to verify that no significant damage has occured to the unit in transit.

1. Set the INVERTER ON/OFF rocker switch located on the front panel of the Mini UPS to the OFF position.
2. Connect the input line cord to an appropriate source.
3. Note that the 'LINE PRESENT' and 'CHARGER ON' lamps illuminate. Should this not occur, verify that AC voltage is present at the source – if it is, check the AC LINE FUSE on the front panel and replace if necessary. Contact your SOLA ELECTRIC representative or the Factory if a problem persists.
4. With the above mentioned lamps illuminated, the rectifier is operating and charging the battery. Let the unit run for thirty (30) minutes and check that no smoke or odor emanates from the system enclosure.
5. Set the INVERTER ENABLE switch, located on the rear panel to ON.
6. Set the INVERTER ON/OFF switch to ON.
7. The 'INVERTER ON' light should gradually illuminate since the inverter takes up to 20 seconds to walk up.
8. Turn the inverter off. Let the rectifier run for twenty-four (24) hours. This is to ensure that the battery is fully charged before the unit is put into operation.
9. Turn the inverter on and verify that the 'INVERTER ON' lamp illuminates.
10. Unplug the input line cord and verify that the inverter continues to operate – only the 'INVERTER ON' lamp should remain illuminated.
11. Turn the inverter off – the unit is ready for operation.

8.0 OPERATING INSTRUCTIONS

1. Plug the critical load into the receptacle on the front panel of the unit.

   NOTE: With the input line cord plugged into an appropriate source, the rectifier operates at all times – and is not switched on-off.
2. Turn the inverter on. Depending on the amount of inrush current the critical load draws, the inverter may shutdown once or twice due to overload before remaining on. Motors, transformers, cold incandescent lamps and power supplies are types of loads that can draw high starting currents. The unit will remain off after the third overload shutdown. To restart the inverter, toggle the INVERTER ON/OFF switch OFF-ON.
3. To restart the inverter after shutdown due to discharge battery or overtemperature, toggle the INVERTER ON/OFF switch OFF-ON.

9.0 AUXILIARY BATTERY CONNECTION

9.1 To extend the battery back-up time, SOLA ELECTRIC auxiliary battery packs are available. Each Mini UPS has a special two-terminal socket just below the rear panel to allow mating with an auxiliary battery pack. Each auxiliary battery pack has two connectors permitting the use of more than one pack with a Mini UPS system. See Section 13.1.

10.0 MAINTENANCE

10.1 The Mini UPS systems are warranted for a period of one (1) year upon delivery to the ultimate user. Conditions of the warranty are given on the warranty page on this manual.

10.2 It is recommended that the unit be calibrated every 12 months as a preventive maintenance tool and also to verify performance. The characteristics to be checked and, if necessary, recalibrated are:

1. Inverter Control Voltage
2. Output Voltage
3. Output Frequency
4. DC Bus (Battery) Voltage

10.3 Refer to Figure 3 for location of the internal potentiometers that may have to be adjusted. A multimeter (such as JOHN FLUKE, Model 8020A) is all that is required to check items 1, 2 and 4. The output frequency can be checked by a frequency meter (such as JOHN FLUKE, Model 1900A) or a general purpose oscilloscope (such as TEKTRONIX 465).

CAUTIONS

DANGEROUS VOLTAGES EXIST INSIDE THE MINI UPS ENCLOSURE WITH AND WITHOUT THE INPUT LINE CORD PLUGGED INTO A MATING SOURCE. ONLY TRAINED PERSONNEL SHOULD ATTEMPT TO SERVICE THIS EQUIPMENT.

THERE IS NO ISOLATION TRANSFORMER AT THE INPUT TO THE RECTIFIER. HENCE THE COMMON CIRCUITS ON THE INVERTER CONTROL BOARD AND THE BATTERY NEGATIVE TERMINAL CANNOT BE EARTH GROUNDED. THIS PRESENTS ADDITIONAL HAZARD TO THE SERVICE TECHNICIAN AND SAFE PRACTICES MUST BE MAINTAINED, SUCH AS USING INSULATED TOOLS AND PROBES.

THE COMMON CIRCUITS ON THE RECTIFIER CONTROL CARD ARE DIRECTLY CONNECTED TO THE BATTERY POSITIVE TERMINAL, WHICH IS COMMON WITH THE INPUT AC LINE THROUGH THE RECTIFIER. HENCE EARTH GROUND CANNOT BE APPLIED AND ADDITIONAL PRECAUTIONS, AS ABOVE, MUST BE MAINTAINED.

10.4 Access to the calibration potentiometers is illustrated in Figure 3.

10.5 Performance and Calibration – the following procedure should be used:

Step 1: Remove the top cover as illustrated in Figure 3. Do not remove the printed circuit cards.

Step 2: Turn the inverter ON. The INPUT LINE CORD SHOULD NOT BE PLUGGED INTO A SOURCE.

Step 3: INVERTER CONTROL VOLTAGE – This should be between 11.9 volt and 12.1 volt. Measure this at TP3 on the INVERTER CONTROL CARD and, if necessary, adjust potentiometer RE50 to set to the correct voltage (use TP6 as the common).

Step 4: OUTPUT VOLTAGE – Measure this by inserting the multimeter voltage probes into the AC receptacle on the front panel. Adjust potentiometer RE91 on the INVERTER CONTROL CARD to set the voltage to the rated value.

Step 5: OUTPUT FREQUENCY – Measure this by inserting oscilloscope or frequency meter probes into the AC receptacle on the front panel. Adjust potentiometer RE54 on the INVERTER CONTROL CARD to set the frequency to the rated value.

Step 6: Turn the inverter OFF.

Step 7: Plug the input line cord into an appropriate source. The 'LINE PRESENT' and 'CHARGER ON' lamps should illuminate.

Step 8: DC BUS VOLTAGE – With the inverter off, measure the DC bus (battery) voltage at terminals 1(+) and 2(–) on the RECTIFIER CONTROL CARD. OBSERVE ABOVE MENTIONED CAUTIONS. The measured voltage should be between 85.0 volt and 87.0 volt. If the voltage is low, note the exact value and set it to 86.0 volt by adjusting potentiometer RE24. Let the rectifier run for 60 minutes – and then check that the bus voltage has not increased. If it has, the battery is taking charge and has not yet reached a steady state value. Should this occur, set the bus voltage back to the original value noted and operate the unit overnight. Repeat the procedure after the battery is charged.

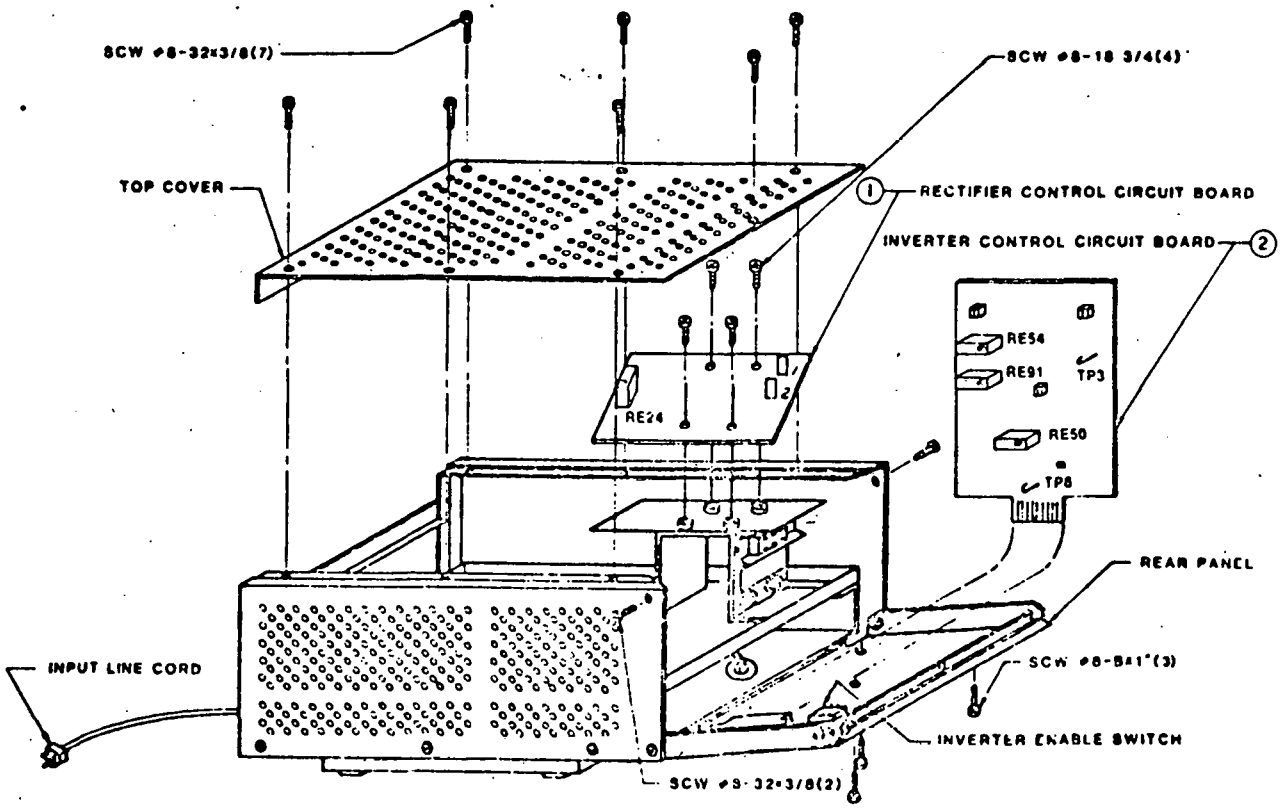


FIGURE 3—CALIBRATION AND/OR REPLACEMENT OF CONTROL CIRCUIT BOARDS

11.0 BATTERY LIFE AND REPLACEMENT

11.1 The battery is kept at float voltage (fully charged) under normal operating conditions. Since every battery has a finite float life and can only undergo a limited number of discharge/charge cycles, it may become necessary to replace it. A useful lifetime cannot be predicted because of the number of variables involved, such as rate of discharge, depth of discharge and operating temperature. The user should determine that the battery needs replacement when it cannot power the inverter more than 60% of its rated back-up time – after having been operated at float voltage for more than 16 hours. The following procedure should be used for replacement of the battery (refer to Figure 4):

Step 1: Unplug the input line cord and the critical load. Make sure the inverter is OFF – (also unplug any auxiliary batteries being used).

Step 2: Open the rear panel as illustrated in figure 4 and remove the two fuses FU1 and FU2.

Step 3: Set the unit on its side and remove the battery compartment (note that replacement involves the entire string of 36 cells and the battery case, rather than individual cells).

Step 4: Detach the battery interconnecting cable.

Step 5: Repeat the above steps in reverse order to install the new battery.

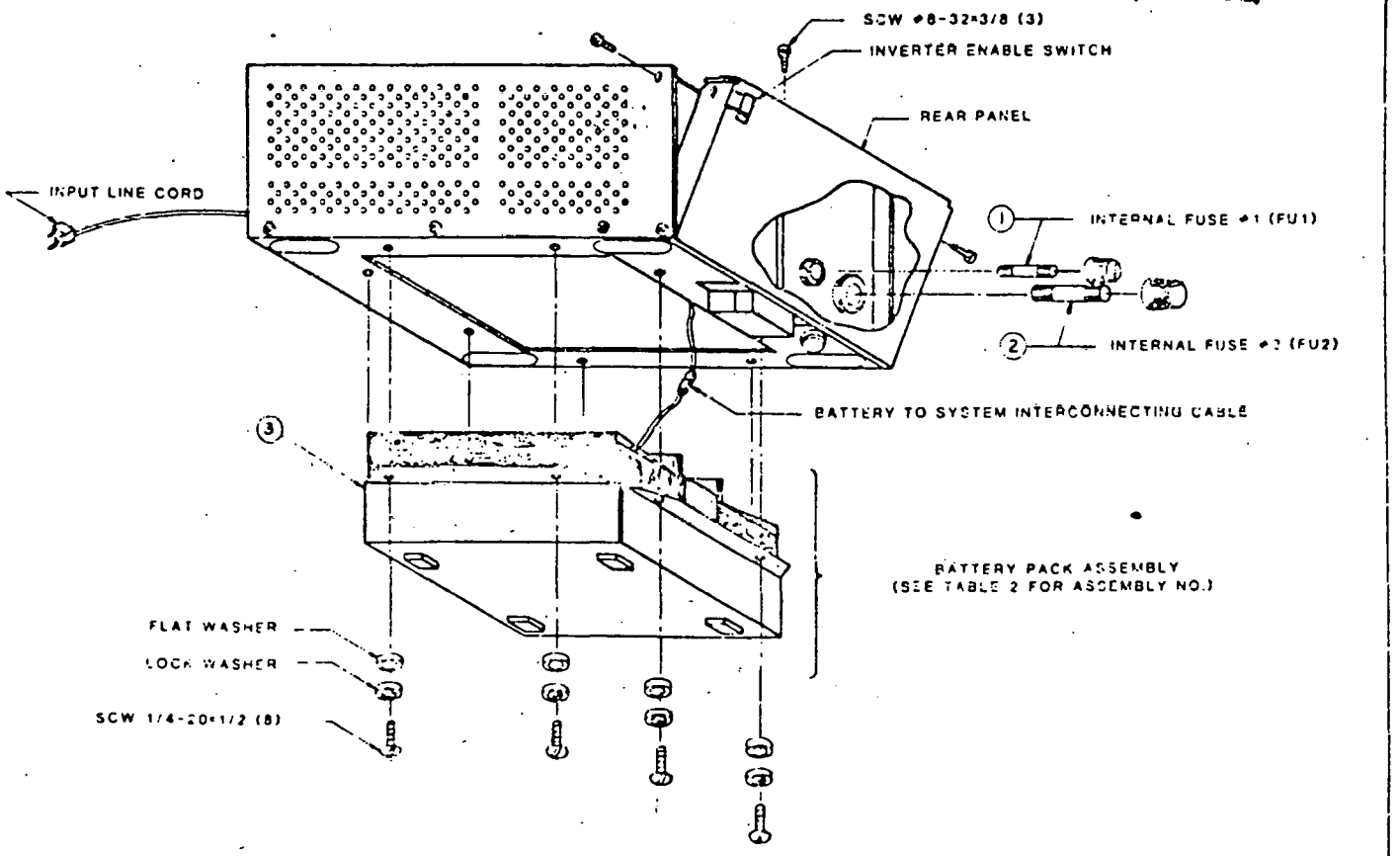


FIGURE 4—REPLACEMENT OF BATTERY

12.0 REPLACEABLE PARTS

12.1 In consultation with the Factory, some electrical parts may be replaced in the field, such as the battery (section 11.0) and the printed circuit card assemblies. Figure 3 illustrates the removal and replacement of the card assemblies. Various mechanical parts that might be physically damaged may also be replaced in the field – Figure 5 illustrates the removal and replacement of these parts. Table 2 lists the replaceable parts called out in the exploded views of Figures 3, 4 and 5. In addition to the SOLA ELECTRIC part number, the Mini UPS catalog number should also be referred to when ordering spare parts.

ACCESSORIES

13.1 Auxiliary Battery Packs – The length of time the Mini UPS system will supply a load after the input AC line has failed is determined by the battery capacity (and, of course, the amount of power drawn by the load). Normal back-up times are specified at rated load with the internal battery for all models. Should longer back-up time be required, an external battery can be connected to the system. Each Mini UPS system has a fused connector to allow for this provision. Refer to SOLA ELECTRIC AUXILIARY BATTERY literature for specific details.

13.2 Battery Supplying Power Signal – In certain applications it is necessary to have an automatic early warning signal that the system is in the emergency mode – and may shutdown due to discharged battery. A set of normally open contacts can be provided to mate with the user's circuits. These contacts close only when the inverter is actually operating and the battery is the only source of DC power. A 3-terminal phone jack is used for connection to the user's circuits. The corresponding mating plug would be of the tip, ring and sleeve (3-terminal) type with 0.25 inch sleeve diameter. The sleeve is automatically earth grounded since the phone jack is mounted on the chassis – which in turn is grounded by the input AC line cord. The tip and ring connect to the relay contacts, which are rated 0.15 amp at 30 VAC or 30 VDC.

PDP - II DISK SYSTEM

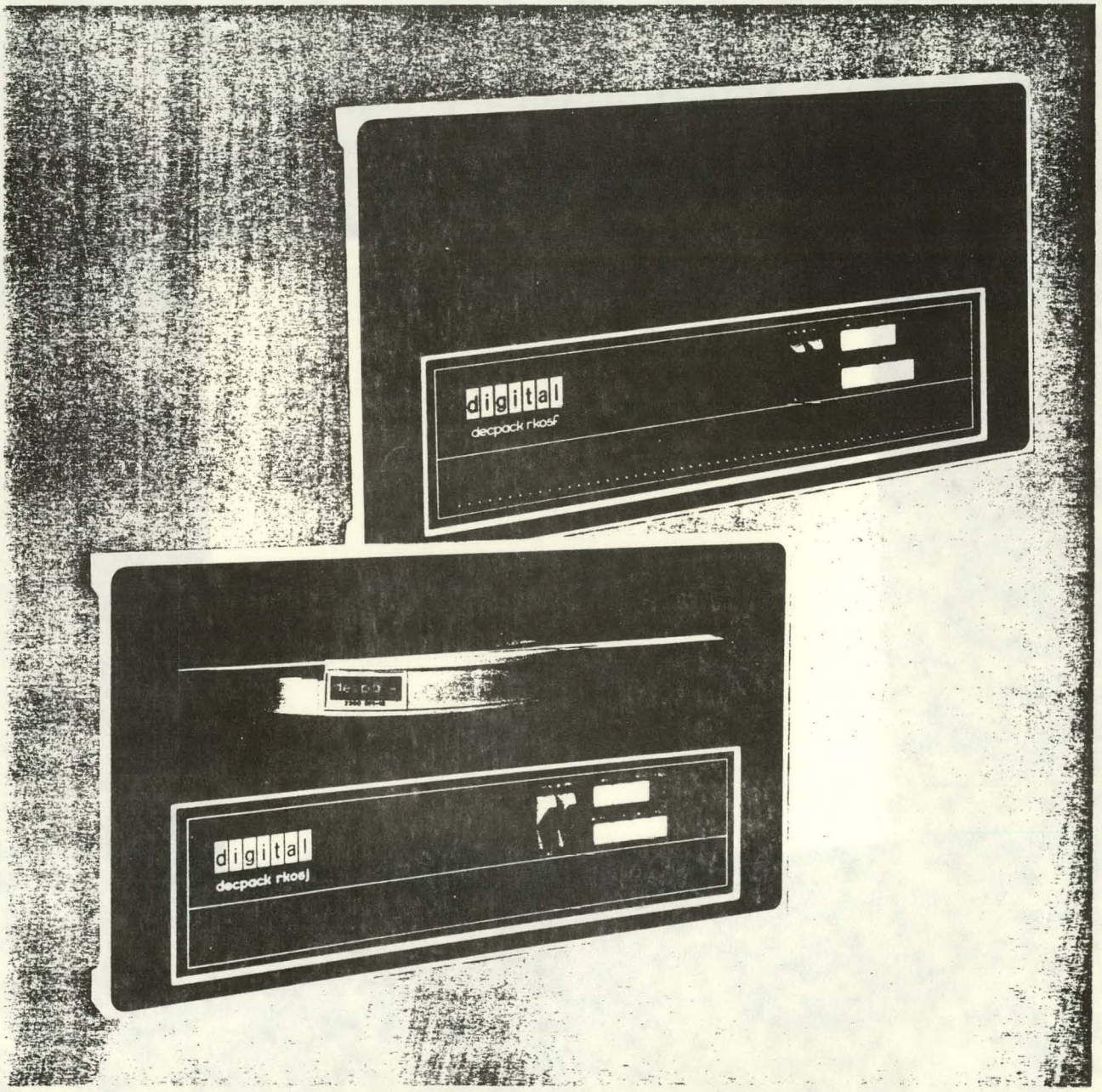
DIGITAL EQUIPMENT CORPORATION

OPTION BULLETIN

PERIPHERALS

JULY 1976

RK05 Disk System Family



LINE PRINTER

A465221B

MAINTENANCE MANUAL

LINE PRINTER

MODEL LP6351

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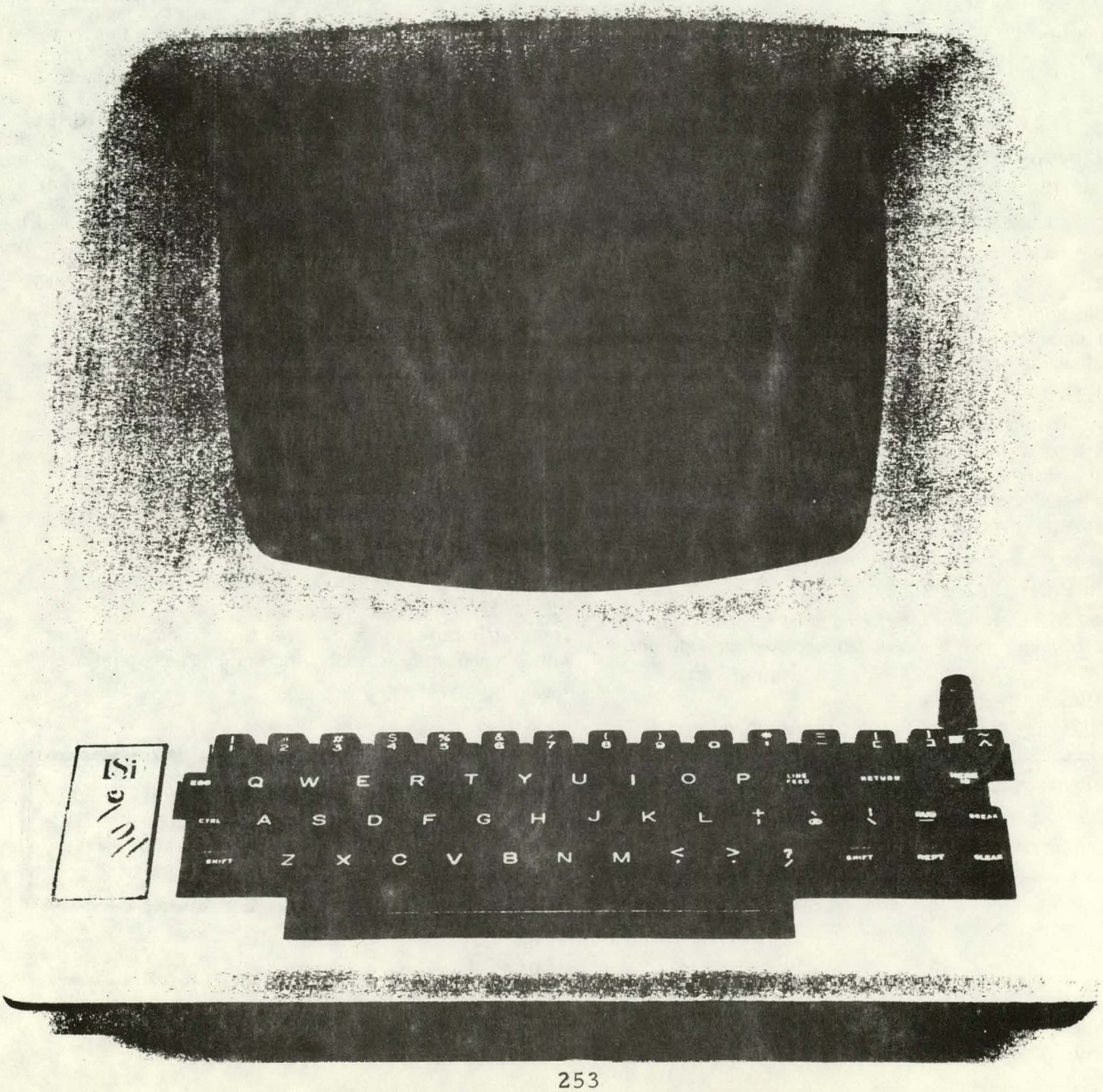
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C R T

DUMB TERMINAL.
SMART BUY.

ADM-3A

addressable cursor



SPECIFICATIONS

DISPLAY
12" (diagonally measured) rectangular CRT screen with P4 phosphor and bonded etched non-glare surface.

DISPLAY FORMAT
Standard: 960 characters, displayed in 12 lines of 80 characters per line.

CHARACTER SET
Standard: 64 ADCII characters, displayed as upper case, plus punctuation and control.

CHARACTER GENERATION
5 x 7 dot matrix.

REFRESH RATE
60 Hz standard.

NUMBER OF KEYS
59 (plus TTY control keys).

DIMENSIONS
13.5" high x 15.6" wide x 20.2" deep.

WEIGHT
32 pounds. 14.5 kilograms.

POWER CONSUMPTION
70 watts at 115V ± 10%

ALTERNATE CONFIGURATIONS
(switch selectable - no cost)

CURSOR
Reverse block image of character over which it is positioned; homes to upper left of screen (switch = PAGE). Underline; homes to lower left of screen (switch = BL).

DATA ENTRY
Data entry on progressive lines, from top to bottom (switch = PAGE); entry on bottom line (switch = BL). Upward scrolling of entire display with top-of-page overflow. Automatic new line also switch-selectable. End-of-line audible tone.

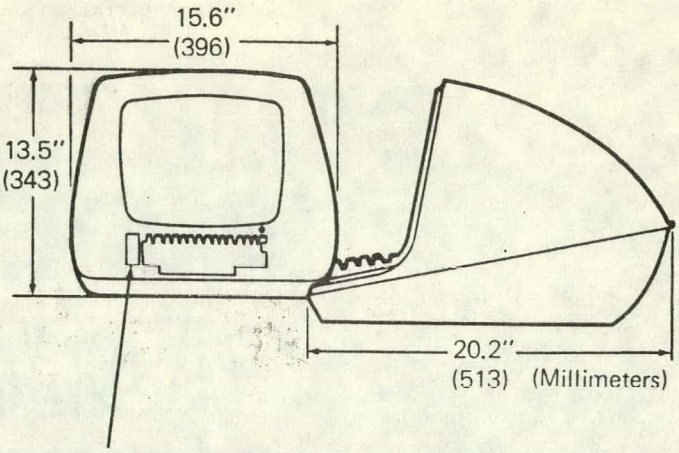
COMPUTER INTERFACES
EIA standard RS232C and 20mA current-loop.

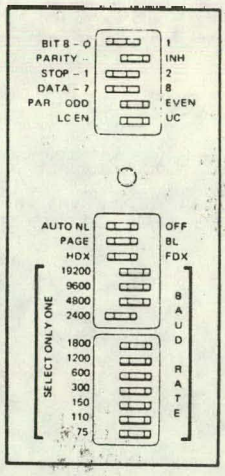
AUXILIARY INTERFACES
Extension RS232C port for interfacing serial asynchronous ASCII hard copy printer, magnetic tape recorder, or additional data terminals.

COMMUNICATION RATES
75, 110, 150, 300, 600, 1200, 1800. 2400, 4800, 9600, 19,200 baud.

TRANSMIT/RECEIVE MODES
Full and half-duplex.

WORD STRUCTURE
Total word length: 9, 10, or 11 bits. Data: 7 bits. Start: 1 bit. Stop: 1 or 2 bits. Parity: 1 bit (odd, even, high, low or none).





FRONT PANEL SWITCHES (SHOWN). Twenty switches for selecting the primary terminal operating characteristics are accessible from the ADM-3A front panel without opening the case or removing power to the unit: BIT 8=0=1. PARITY—INH. STOP-1-2. DATA-7-8. PARITY-ODD -EVEN. LOWER CASE/UPPER CASE. AUTO. NEW LINE—OFF. PAGE—BL. HALF/FULL DUPLEX.

COMMUNICATION RATE SWITCHES: 19200. 9600. 4800. 2400. 1800. 1200. 600. 300. 150. 110. 75.

NOT SHOWN: In addition to the front panel switches, the PC board inside the ADM-3A case contains 12 switches which allow selection of various terminal operating characteristics, such as: UC DISP—U/L DISP (OPTIONAL). DISABLE—KB LOCK. DISABLE—CLEAR SCREEN. —SEC CHAN. END OF TEXT. END OF TRANSMISSION RS232-CL.

OPTIONS (at additional cost)

Display Format: 1920 characters, 24 lines of 80 characters per line.

Character Set: Upper and lower case, full set of 90 ASCII characters (switch selectable) upper case only; 10-key numeric pad.

Refresh Rate: 50Hz with input power option, switch selectable.

Transmit/Receive Modes: "Answer Back" capability with independently selectable transmit and receive rates.

Power: 50/60 Hz 230 Vac ± 10%.



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